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STATE OF VERMONT.

FOURTH

Annual Report

OF THE

State Agricultural

Experiment Station.

1890.

BURLINGTON:
THE FREE PRESS ASSOCIATION.
1891.

THE VERMONT STATE

Agricultural * Experiment * Station.

BURLINGTON, VT.

BOARD OF CONTROL.

OFFICERS OF THE STATION.

ANNOUNCEMENT.

The Vermont State Agricultural Experiment Station was established in accordance with an act of the General Assembly approved Nov. 24th, 1886, for the purpose of promoting agriculture by scientific investigation and experiment.

The Station is prepared to analyze and test fertilizers, cattle foods, seeds, soils, milk and other agricultural materials and products, to identify grasses, weeds and useful or injurious insects, and to give information on various subjects of agricultural science for the use and advantage of the citizens of Vermont.

All chemical analyses, seed investigations, etc., proper to an Experiment Station, that can be used for the public benefit, will be made without charge. The Station will undertake no work the results of which are not at its disposal to use or publish if deemed advisable for the public good. The results of each analysis or examination will be promptly communicated to the party sending the sample. Those that are of general interest will be published in bulletins, copies of which will be sent to each post-office in the State. The work of the year will be summed up in the annual report of the Station.

It is the wish of the Board of Control to make the Station as widely useful as its resources will admit. Every Vermont citizen who is concerned in agriculture, whether farmer, manufacturer or dealer, has the right to apply to the Station for any assistance that comes within its province to render, and the Station will respond to all applications as far as it lies in its power. All communications on agricultural and horticultural topics will be fairly considered and as far as possible promptly answered. Any one desiring to send samples or specimens for examination should first write to the Experiment Station and get blanks and directions for taking samples.

Parcels by express, to receive attention, should be prepaid.

The Station offices and laboratory are in the Station Building, corner of Main St. and University Place. The Station farm is in South Burlington. The Station has telephone connection and may be spoken from the

Central Telephone Office and any Hotel in Burlington, and from the Telephone Stations at Essex Junction, Richmond, Charlotte, Shelburne, Winooski and Montpelier.

W. W. COOKE, Director,
Burlington, Vt.

☞ Address all communications, not to any individual officer, but to the Agricultural Experiment Station, Burlington, Vt.

TABLE OF CONTENTS.

FINANCIAL REPORT

FOR THE FISCAL YEAR ENDING JUNE 30, 1890.

The State Agricultural Experiment Station

OF VERMONT

In Account with the United States.

Dr.		
To appropriation		$15,000 00
Cr.		
By Salaries	$6,186 63	
" Labor	2,540 74	
" Buildings	117 42	
" Water, gas, fuel and telephone	610 41	
" Library	67 36	
" Apparatus	444 91	
" Chemicals	364 94	
" Horticultural supplies	296 23	
" Vehicles and team equipments	107 67	
" Tools and farming implements	229 59	
" Stationery, postage and telegrams	241 80	
" Printing	1,580 46	
" Live stock	598 50	
" Traveling expenses	270 22	
" Furniture	87 70	
" Freight, cartage and express	108 03	
" Incidentals	269 13	
" Supplies	878 26	
		$15,000 00

We, the undersigned, duly appointed auditors for the corporation, hereby certify that we have examined the books and accounts of the Experiment Station of the University of Vermont and State Agricultural College, for the fiscal year ending June 30, 1890; and that we have found the same well kept and correctly classified as above, and that the receipts for the time named are shown to have been $15,000.00 and the corresponding disbursements $15,000.00, for all of which proper vouchers are on file, and have been by us examined and found correct.

M. H. BUCKHAM,
CROSBY MILLER,
Auditing Committee of the Board of Trustees.

I hereby certify that the foregoing statement of accounts, to which this is attached, is a true statement from the books of accounts of the institution named.

{ SEAL. }

H. O. WHEELER,
Treasurer.

We, the undersigned, do hereby certify that the above is the signature of H. O. Wheeler, treasurer of the University of Vermont and State Agricultural College, and that the above is the seal of said institution.

W. W. COOKE,
Director Experiment Station.

G. G. BENEDICT,
Sec. U. V. M. State Agricultural College.

FINANCIAL REPORT.

The State Agricultural Experiment Station

In Account with the State of Vermont:

Dr.		
To appropriation		$5,250 00
Cr.		
By Creamery and piggery at farm	$2,107 56	
" Repairs on farm house	546 87	
" Farm supplies	309 80	
" Engine and shafting	426 16	
" Repairs at Station Laboratory	472 26	
" Gas machine, Station	503 42	
" Barn, Station	883 93	
		$5,250 00

NOTE. The above appropriation is the last money given by this State, to the Experiment Station. The State has given, in all $12,250.00, and a report of the expenditure of the first $7,000,00 of this sum will be found on page 152 of the annual report of the Station for 1887; the remainder is given above.

The State ceased January 1, 1890, to make further appropriations for the support of the Station, and its income now has to be derived entirely from the general government.

Report of the Director.

The present report covers the work done at the Station from December 1, 1889 to December 1, 1890; the financial report covers the year ending June 30, 1890.

PUBLICATIONS.

During the year five bulletins have been issued as follows:

January. No. 18. Pig Feeding

April. No. 19. Questions Concerning Injurious Insects.

May. No. 20. Analyses of Licensed Fertilizers.

September. No. 21. Milk Testing.

October. No. 22. Fair Ground Tests of Dairy Cows.

There have also been issued:

March	Newspaper Bulletin No. 1.	The Wastes of the Dairy.
June	" " " 2.	The Potato Rot and Apple Scab.
August	" " " 3.	Raising Cream with Hot Water.

An Annual Report was also issued embracing the work of the Station for the year ending December 31, 1889.

These bulletins were printed in editions of eight thousand each, except No. 21, for which an extra edition of five thousand more had to be published to supply the demand.

An abstract of these bulletins is given in this report. There are a few copies yet on hand of the former bulletins, that will be sent to those desiring as long as the supply lasts.

Changes in Station Staff and Equipment.

The personnel of the working force has changed but little during the year. Mr. D. W. Colby and Mr. F. L. Barrows have resigned and Mr. A. B. Cordley of the Michigan Agricultural College has been appointed Microscopist of the Station. Miss Jessie M. Lawrence has been succeeded as Stenographer by Miss Cora F. Marsh.

A barn has been erected at the Station in town, and quite extensive changes and repairs made on the Station building.

Ever since the station began work at its present farm, three and a half miles from the office and laboratory, it has had to work at a great disadvantage owing to this division of its forces. We are happy to be able to announce now that a new farm has been purchased joining the present University grounds, and during the coming season a full set of farm buildings will be erected near the present offices.

The work of building and removal will largely occupy the attention of the Station staff this season, but when the work is completed we shall have the satisfaction of knowing that the Vermont Station is one of the best equipped in the United States for general work, and in the particular line of dairying is not surpassed by any.

The new farm contains a good variety of soils from the heavy clay, through clay loam and sandy loam to light soil and is well adapted for experimental purposes. The buildings to be erected include a dwelling house, creamery, carpenter shop, greenhouse, with accompanying rooms for potting plants and general work, horticultural and botanical, and a large barn with accommodations for cattle, sheep and pigs. The greenhouse will be heated by hot water, and a separate boiler will supply steam to the creamery and drive the engine for running the separator and the ensilage cutter. Taken all together it will be a very creditable equipment, and by the last of September we shall be in full running order.

Work of the Year.

The work of the Station during the past year may be considered under the following heads, taking them in the order they occur in this report:

Fertilizers.—The usual routine work in this line has been carried on, and although it may seem a useless expenditure of time and money, its true value can be easily seen by comparing the analyses this year with those of four or five years ago. This year's figures show that there is not a poor fertilizer now on the markets of this State. This in itself is a remarkable showing and it means simply this, that the manufacturers have learned by experience that their goods will be thoroughly tested after they reach the State, that these tests will be made from samples drawn from all over the State, so that there is risk in allowing any damaged or low grade goods to enter our markets, and lastly they know that the results of these tests are scattered broadcast over the State and are examined by the farmers who are intending to purchase. The result is shown in the analyses. The smaller firms have left the State, the larger ones have year by year raised the quality of their goods, at the same time that competition has lowered the price, until now the leading brands of the various companies are practically the same thing. The question before the manufacturer is no longer, how low a grade of goods he can successfully float on the market, but the strife comes in purchasing good materials at the lowest possible cost, manufacturing it with the greatest economy and putting on the market with as little expense as possible for agents, salaries and commissions.

It is noticeable that the prejudice against the fertilizer men is fast dying out. They have brought their work down to sound business principles and the rank and file of the farmers have ceased to look upon them with suspicion. While gratifying progress has been made in this respect, it is too bad that the whole fertilizer business should still be hampered and injured by the credit system. There is no reason why fertilizers should be treated differently from other merchandise. The man who is able to pay does not stipulate when he buys a barrel of sugar, that payment shall not be expected until five to eight months later, and that if his crops are poor he will expect a rebate. It will be a fortunate day for both the farmer and the manufacturer when this credit system is abandoned, and though the reduction in price for cash payments cannot be so great now as it could three

years ago, yet on the business of the State it would amount to many thousand dollars. Attention is once more called to the great variations in quality of the several samples of ashes analyzed and the consequent advisability of testing them before purchasing in quantity.

Water.—The analyses of drinking water on page 32, are worthy of a careful study. Several of these samples such as Nos. 1600, 1693 and 1607 show the great purity of Vermont spring and well water where it has not been contaminated by the agency of mankind. It is probable that when the wells were first dug, from which the other samples were taken, that the water was equally pure, but the presence of animals and mankind for several generations has saturated the ground with impurity and the germs of disease, until it behooves all farmers in the State to scan with the closest scrutiny the source of their water supply. Several of these samples were sent on account of the appearance of typhoid fever in the neighborhood, and their analysis shows an alarming state of impurity.

Pig Feeding.—As an adjunct of the dairy this is one of the most important of the minor industries of the State. Creamery men inform us that most of our farmers are willing to sell their skimmilk at 10c to 12c per 100 pounds, while the figures presented here show that it is worth as much as that to *pour out on the ground as a fertilizer.* In the two years' work of pig feeding recorded in this report, there has been a net receipt from the skimmilk of about 25c per 100 pounds and still leave most of its fertilizing value to offset the labor of caring for the pigs. The result was obtained by paying attention to two requisites: first that the skimmilk be fed to young growing pigs, and second that it be fed in connection with small amounts of grain. It should be noticed that the skimmilk used in these trials was not the warm, fresh, sweet skimmilk about which platform speakers and dairy writers continuously talk, but was ordinary cold, sour skimmilk. A test is now in progress in this Station to determine whether the carefully handled sweet skimmilk will produce any more pounds of pork than the common sour milk. If our farmers are willing to sell their skimmilk for 10c a hundred, it indicates a conviction on their part that they do not actually get more than that out of it. What an immense gain it would be to the State if, by a more economical and proper use, this milk could be made to net 20c per 100 pounds. It would mean nearly thirty dollars per year per farm, or more than a million dollars a year for the State.

Milk Testing.—Probably the most important work of the Station during the year has been in the line of dairying, and especially in the testing of

milk. The general interest awakened in the subject is shown by the fact that the tables given in our first bulletin on the subject have been widely copied and used by other Stations and implement manufacturers, and by the further fact that an edition of eight thousand copies of our second bulletin was exhausted in a few weeks, and an extra edition of five thousand copies required to supply the demand. A wonderful progress in the matter of milk testing has been made in the State during the past year. A year ago there were less than seventy-five farmers receiving pay for their milk according to its actual value for butter making. Now there are over a thousand. The hard part of the struggle is now over, and it is but the matter of a few month's time when all the milk brought to either creamery or cheese factory, will be paid for according to its exact value for butter or cheese. The value of this to the dairy interests of the State can hardly be overestimated. It will take several years before the results will be apparent, but they are sure to come. Already hundreds of farmers are preparing to change to winter dairying, since they have long known the fact that the winter milk is richer than summer, and if they can receive extra pay for this extra richness it means a large extra increase in the profits of the dairy.

INSPECTION OF FERTILIZERS.

The preceding reports of this Station have contained full discussions of the terms used in fertilizer analyses, the methods of analysis and the questions relating to fertilizer valuations. It is deemed unnecessary to repeat these, and therefore the analyses themselves are all that will here be given. The reader is referred to previous reports for further information.

The present fertilizer law of Vermont can be found on page 25 of the Experiment Station Report for 1889.

The analyses given on the following pages are in all cases on samples that had been brought into the State since January 1, 1890, and unless otherwise stated the samples were drawn by the director of the Station, either personally or by deputy. The methods used for analysis are those adopted by the Association of Official Agricultural Chemists.

OBSERVANCE OF THE FERTILIZER LAW.

List of manufacturers who have paid licenses as required by the fertilizer law and of the fertilizers they have offered for sale in the State during the year ending December 31, 1890.

FIRM.	BRAND OF FERTILIZERS.
Bowker Fertilizer Co.,	Bowker's Hill and Drill Phosphate.
Boston, Mass.	Stockbridge Manures.
	Potato Phosphate.
	Ammoniated Bone Fertilizer.
	Sure Crop.
Bradley Fertilizer Co.,	Bradley's X L Superphosphate.
Boston, Mass.	B. D. Sea Fowl Guano.
	Potato Manure.
	Bradley's Eclipse Phosphate.
Crocker Chemical & Fertilizer Co.,	Crocker's Buffalo Ammoniated Bone Superphosphate.
Buffalo, N. Y.	Crocker's Buffalo Superphosphate for Potatoes, Hops and Tobacco.
	Crocker's Buffalo Special Superphosphate.
	Crocker's Ammoniated Corn Phosphate.
	Crocker's New Rival Ammoniated Superphosphate.

Clark's Cove Guano Co., J. S. Reese, Licensee, New Bedford, Mass.	King Philip Alkaline Bone. Unicorn. Bay State Fertilizer. Concentrated Corn and Potato Manure. Pilgrim.
Cleveland Dryer Co., Cleveland, O.	Cleveland Superphosphate. Cleveland Potato Phosphate.
Coe, E. Frank, New York, N. Y.	High Grade Superphosphate. Alkaline Bone. Ammoniated Bone Superphosphate.
Cumberland Bone Co., Portland, Me.	Cumberland Superphosphate. Cumberland Seeding Down Fertilizer.
Davidge Fertilizer Co., New York, N. Y.	Special Favorite.
Lister Brothers, Newark, N. J.	Success. Potato Fertilizer. Potato Special, No. 2.
Quinnipiac Co., New London, Conn.	Quinnipiac Phosphate. Quinnipiac Potato Manure. Pine Island Phosphate.
Standard Fertilizer Co., Boston, Mass.	Standard Fertilizer. Standard Guano.
Stewart & Co., W. D. Boston, Mass.	Soluble Pacific Guano.
Williams & Clark Co., New York, N. Y.	Americus Ammoniated Bone Superphos. Potato Phosphate.

LICENSED FERTILIZERS SAMPLED BY STATION.

Station Number.	BRAND.	Drawn at.	Drawn from.
4012	Bradley's Eclipse Phosphate	St. Albans	H. B. Weeks
4014	Williams & Clark Co.'s Potato Phosphate	St. Albans	Clark & Hatch
4015	Williams & Clark Co.'s Americus A. B. Superphosphate	Richford	M. R. Goff
4017	Bradley's X. L. Superphosphate	Newport	Sherman & Braidy
4020	Bowker's Potato Phosphate	Newport	E. B. True
4022	Bowker's Stockbridge Potato Manure	Newport	E. B. True
4024	Reese's King Philip Alkaline Guano	Newport	True & Blanchard
4025	Reese's Unicorn	Newport	True & Blanchard
4026	Lister's Success	Newport	A. W. Pratt
4028	Bradley's Potato Manure	St. Johnsbury	E. K. Ide
4029	Quinnipiac Pine Island Phosphate	St. Johnsbury	B. F. Weeks
4031	Reese's Bay State Fertilizer	St. Johnsbury	Wilder, Noyes & Co.
4033	Reese's Concentrated Corn and Potato Manure	St. Johnsbury	Wilder, Noyes & Co.
4035	Cumberland Superphosphate	St. Johnsbury	Thos. Gagner
4039	Buffalo Potato, Hop and Tobacco Phosphate	Wolcott	Geo. Taylor
4041	E. F. Coe's H. G. Ammo. Bone Superphosphate	Morrisville	G. J. Slayton
4045	Buffalo Ammo. Corn Phosphate	Hyde Park	E. Sherwin

ANALYSES OF LICENSED FERTILIZERS.

Station Number.	BRAND.	NITROGEN.			PHOSPHORIC ACID.											POTASH.		
					Soluble.		R'v't'd		Ins'l'ble		Available.		Total.					
		Found.	Guaranteed.	Valuation at Station Prices.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.	Valuation at Station Prices.	Found.	Guaranteed.	Valuation at Station Prices.
4012	Bradley's Eclipse Phosphate	1.45	1	$ 4 93	6.83	8	2.86	2	1.88	2	9.69	10	11.57	12	$16 35	1.77	1.50	$1 59
4014	Williams & Clark Co.'s Potato Phos.	2.67	2	9 08	6.01	6	1.48	1	1.27	...	7.49	....	8.76	8	12 59	6.31	6	5 68
4015	Williams & Clark Co.'s Am. A.B. Super	2.46	2	8 36	7.77	7	1.67	3	1.24	...	9.44	....	10.68	11	15 68	3.43	2	3 09
4017	Bradley's X. L. Superphosphate	2.60	2.50	8 84	8.05	7	1.76	2	1.88	2	9.81	9	11.69	11	16 65	2.09	2	1 88
4020	Bowker's Potato Phosphate	2.75	2.47	9 35	5.92	....	2.64	...	5.33	...	8.56	7	13.89	13	16 63	2.91	3	2 62
4022	Bowker's Stockbridge Potato Manure	3.29	3.25	11 18	3.38	....	4.53	...	4.13	...	7.91	7	12.04	8	14 69	5.59	5	5 03
4024	Reese's King Philip Alkaline Guano	1.79	1.23	6 09	5.55	4 50	1.18	2	2.31	1	6.73	6.50	9.04	7.5	12 03	3.66	3	3 29
4025	Reese's Unicorn	2.06	1.30	7 00	6.64	6	2.34	3	3.59	1.50	8.98	8.50	12.57	10	16 28	3.45	2	3 11
4026	Lister's Success	1.94	1.03	6 60	6.54	....	2.92	...	2.66	...	9.46	10	12.12	...	16 44	1.80	1	1 62
4028	Bradley's Potato Manure	2.80	2.50	9 52	5.19	5	2.42	1	1.90	2	7.61	6	9.51	8	13 07	5.87	5	5 28
4029	Quinnipiac Pine Island Phosphate	2.58	2	8 77	4.15	6	6.64	3	1.62	1	10.79	....	12.41	...	17 57	1.56	1	1 40
4031	Reese's Bay State	2.73	2.47	9 28	5.64	7	4.06	2	4.29	...	9.70	9	13.99	11	17 69	2.49	2	2 24
4033	Reese's Concent. Corn & Potato Manu.	2.88	2.80	9 79	4.33	4	2.44	2	2.42	1	6.77	6	9.19	7	12 03	7.75	7	6 98
4035	Cumberland Superphosphate	2.50	2	8 50	4.99	5	6.13	4	3.01	1	11.12	....	14.13	12	18 99	2.15	2	1 94
4039	Buffalo Potato, Hop, Tobacco Phos.	2.12	2	7 21	7.40	6	1.55	2	1.76	1	8.95	8	10.71	...	15 23	4.07	3.50	3 66
4041	E. F. Coe's H. G. Am. Bone Superphos.	1.98	2	6 73	8.21	7	1.98	2	2.13	2	10.19	6	12.32	11	17 39	2.57	2	2 31
4045	Buffalo Ammo. Corn Phosphate	2.23	2.05	7 58	6.69	8	1.84	2	2.35	1	8.53	10	10.88	...	14 87	2.95	1.60	2 66

LICENSED FERTILIZERS SAMPLED BY STATION.

Station Number.	BRAND.	Drawn at.	Drawn fom.
4046	Bradley's Complete Manure	Plainfield	G. D. Kidder
4048	Cleveland Potato Phosphate	Plainfield	G. D. Kidder
4049	Reese's Pilgrim	Newbury	C. J. Richardson
4051	Davidge's Special Favorite	Newbury	J. Wallace
4052	Bradley's B. D. Sea Fowl Guano	Bradford	H. A. Winship
4053	Bowker's Stockbridge Manure for Corn	Bradford	E. H. Welton
4054	Bowker's Sure Crop	Bradford	E. H. Welton
4055	Bowker's Hill and Drill Phosphate	Bradford	E. H. Welton
4057	Cumberland Seeding Down Fertilizer	Northfield	J. M. Temple
4058	Quinnipiac Potato Manure	Barre	W. F. Richardson
4071	Quinnipiac Phosphate	St. Johnsbury	B. F. Weeks
4072	Quinnipiac Pine Island Phosphate	St. Johnsbury	B. F. Weeks
4073	E. Frank Coe's High Grade A. B. Superphosphate	Morrisville	G. J. Slayton
4074	E. Frank Coe's Ammo. Bone Superphosphate	Morrisville	G. J. Slayton

ANALYSES OF LICENSED FERTILIZERS.

Station Number.	BRAND.	NITROGEN. Found.	NITROGEN. Guaranteed.	NITROGEN. Valuation at Station Prices.	PHOSPHORIC ACID. Soluble. Found.	Soluble. Guaranteed.	R'v't'd Found.	R'v't'd Guaranteed.	Ins'l'ble Found.	Ins'l'ble Guaranteed.	Available. Found.	Available. Guaranteed.	Total. Found.	Total. Guaranteed.	Valuation at Station Prices.	POTASH. Found.	POTASH. Guaranteed.	POTASH. Valuation at Station Prices.
4046	Bradley's Complete Manure	3.83	3.73	$13 02	6.15	6	2.23	2	1.29	1	8.58	8	9.87	9	$14 28	5.42	6	$4 88
4048	Cleveland Potato Phosphate	2.21	2.05	7 51	8.13	6	1.78	2	1.27	2	9.91	8	11.18	.....	16 44	2.68	3.25	2 41
4049	Reese's Pilgrim	1.81	1.	6 15	5.22	4.50	1.02	2	2.29	1	6.24	6.50	8.53	7.50	11 26	3.22	2.50	2 90
4051	Davidge's Special Favorite	1.46	0.82	4 96	9.27	....	0.56	--	0.01	--	9.83	10	9.84	11	15 68	1.83	1.50	1 65
4052	Bradley's B. D. Sea Fowl Guano	2.82	2.50	9 59	8.12	7	1.47	2	1.56	2	9.59	9	11.15	11	16 14	2.91	2	2 62
4053	Bowker's St'ckb'ge Man. for Corn	3.21	3.25	10 91	5.25	....	2.26	--	4.06	--	7.51	8	11.57	9	14 23	3.96	4	3 56
4054	Bowker's Sure Crop	1.15	0.82	3 91	4.00	....	5.18	--	4.43	--	9.18	9	13.61	11	16 83	1.55	1	1 40
4055	Bowker's Hill and Drill Phosphate	2.55	2.50	8 67	7.77	....	2.44	2	2.57	--	10.21	8	12.78	12	17 63	2.04	2	1 84
4057	Cumberl'nd Seed'g Down Fertiliz'r	1.75	1.65	5 95	2.48	2	4.23	3	11.61	11	6.71	.....	18.32	18	17 29	1.26	1	1 13
4058	Quinnipiac Potato Manure	3.40	2.50	11 56	2.63	3	3.99	2	2.01	1	6.62	.....	8.63	.....	11 42	5,27	5	4 74
4071	Quinnipiac Phosphate	3.03	2.50	10 30	3.20	6	7.49	3	2.45	1	10.69	.....	13.14	.....	17 83	2.08	2	1 87
4072	Quinnipiac Pine Island Phosphate	2.88	2	9 79	3.81	6	7.11	3	1.94	1	10.92	.....	12.86	.....	17 93	1.33	1	1 20
4073	E. F. Coe's High Gr. A B Super.	2.05	2	6 97	8.38	7	1.64	2	2.00	2	10.02	9	12.02	11	17 07	2.47	2	2 22
4074	E. F. Coe's Ammo. Bone Super.	1.84	1.50	6 25	7.68	6	2.35	2	2.77		10.03	8	12.80	.....	17 48	1.51	1.35	1 36

AVAILABILITY OF NITROGEN IN FERTILIZERS.

Station Number.	BRAND.	Total Nitrogen.	Nitrogen from Ammonia Salts.	Nitrogen from Nitrates.	Organic Nitrogen.	Organic Nitrogen soluble in Pepsin solution.	Per cent of Organic Nitrogen soluble in Pepsin solution.	Per cent of total Nitrogen immediately available.
4012	Bradley's Eclipse Phosphate	1.45	0.14	....	1.31	0.91	69	72
4014	Williams & Clark Co.'s Potato Phosphate	2.67	0.46	0.20	2.01	1.39	69	77
4015	Williams & Clark Co.'s Americus Ammo. Bone Superphosphate	2.46	0.51	....	1.95	1.37	70	76
4017	Bradley's X. L. Superphosphate	2.60	0.24	0.20	2.16	1.35	63	69
4020	Bowker's Potato Phosphate	2.75	0.12	0.51	2.12	1.37	65	73
4022	Bowker's Stockbridge Potato Manure	3.29	0.78	0.71	1.80	1.21	67	82
4024	Reese's King Philip Alkaline Guano	1.79	0.23	....	1.56	0.85	54	60
4025	Reese's Unicorn	2.06	0.29	....	1.77	1.14	64	70
4026	Lister's Success	1.94	0.38	....	1.56	0.76	49	59
4028	Bradley's Potato Manure	2.80	0.11	0.49	2.20	1.66	75	81
4029	Quinnipiac Pine Island Phosphate	2.58	0.64	....	1.94	0.94	48	61
4031	Reese's Bay State Fertilizer	2.73	0.31	....	2.42	1.42	59	63
4033	Reese's Concentrated Corn and Potato Manure	2.88	0.23	0.31	2.34	1.48	63	70
4035	Cumberland Superphosphate	2.50	0.29	0.37	1.84	1.47	80	85
4039	Buffalo Potato, Hop and Tobacco Phosphate	2.12	0.19	....	1.93	1.27	66	69
4041	E. F. Coe's High Grade Ammo. Bone Superphosphate	1.98	0.58	....	1.40	0.91	65	75
4045	Buffalo Ammo. Corn Phosphate	2.23	0.19	....	2.04	1.25	61	65

AVAILABILITY OF NITROGEN IN FERTILIZERS.

Station Number.	BRAND.	Total Nitrogen.	Nitrogen from Ammonia Salts.	Nitrogen from Nitrates.	Organic Nitrogen.	Organic Nitrogen soluble in Pepsin solution.	Per cent. of Organic Nitrogen soluble in Pepsin solution.	Per cent of total Nitrogen immediately available.
4046	Bradley's Complete Manure	3.83	1.23	0.36	2.24	1.73	77	87
4048	Cleveland Potato Manure	2.21	0.18	....	2.03	1.38	68	71
4049	Reese's Pilgrim	1.81	0.23	....	1.58	0.94	60	65
4051	Dividge's Special Favorite	1.46	0.12	....	1.34	0.30	22	29
4052	Bradley's B. D. Sea Fowl Guano	2.82	0.13	0.44	2.25	1.50	67	73
4053	Bowker's Stockbridge Manure for Corn	3.21	0.18	1.04	1.99	1.54	77	86
4054	Bowker's Sure Crop	1.15	0.21	0.08	0.86	0.46	53	65
4055	Bowker's Hill and Drill Phosphate	2.55	0.13	0.47	1.95	1.46	75	81
4057	Cumberland Seeding Down Fertilizer	1.75	0.14	0.43	1.18	0.82	69	79
4058	Quinnipiac Potato Manure	3.40	0.54	0.63	2.23	1.24	56	71
4071	Quinnipiac Phosphate	3.03	0.47	0.35	2.21	1.32	60	71
4072	Quinnipiac Pine Island Phosphate	2.88	0.66	....	2.22	1.25	56	66
4073	E. Frank Coe's High Grade Ammo. Bone Superphosphate	2.05	0.59	....	1.46	1.07	73	81
4074	E. Frank Coe's Ammo. Bone Superphosphate	1.84	0.22	....	1.62	1.22	75	78

LICENSED FERTILIZERS SAMPLED BY MANUFACTURERS.

Station Number.	BRAND.	Manufactured by.
4061	Buffalo Ammoniated Bone Superphosphate	Crocker Fertilizer and Chemical Co., Buffalo, N. Y.
4063	Buffalo Special Superphosphate	" " " " " "
4064	Buffalo New Rival Ammo. Superphosphate	" " " " " "
4066	Lister's Potato Fertilizer	Lister's Agricultural Chemical Works, Newark, N. J.
4067	Lister's Potato Special No. 2	" " " " " "
4068	Soluble Pacific Guano	W. D. Stewart & Co., Selling Agents, Boston.
4069	Cleveland Superphosphate	Cleveland Dryer Co., Cleveland.
4080	Bowker's Ammoniated Bone Fertilizer	Bowker Fertilizer Co., Boston and New York.

ANALYSES OF LICENSED FERTILIZERS.

Station Number.	BRAND.	NITROGEN.			PHOSPHORIC ACID.											POTASH.		
					Soluble.		Rev'ted.		Ins'ble.		Avail'ble		Total.					
		Found.	Guaranteed.	Valuation at Station Prices.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.	Valuation at Station Prices.	Found.	Guaranteed.	Valuation at Station Prices.
4061	Buffalo Ammo. Bone Superphos.	3.22	2.90	$10 95	6.29	8	1.69	2	2.22	1	7.98		10.20		$13.93	2.04	1	$1 84
4063	Buffalo Special Superphosphate	2.13	1.65	7 24	6.42	6	0.90	2	3.58	1	7.32		10.90		13.77	2.50	1	2 25
4064	Buffalo New Rival Am.Superphos.	1.51	1.15	5 13	5.89	8	1.86	2	2.84	1	7.75		10.59		13.92	3.01	1.60	2 71
4066	Listers Potato Fertilizer	7.32	3.70	24 89	5.49		1.21		0.47		6.70	8.50	7.17		10.88	3.77	7	3 39
4067	Listers Potato Special No.2	2.40	1.80	8 16	6.82		5.11		2.75		11.93	9.25	14.68		20.23	4.52	4	4 07
4068	Soluble Pacific Guano	2.37	2.25	8 06	7.65	7	2.40	1.50	1.75	2	10.05		11.80	10	16.89	2.10	2	1 89
4069	Cleveland Superphosphate	2.58	2.05	8 77	8.13	7	1.80	2	1.94	2	9.93	9	11.87	10.50	16.87	1.90	2	1 71
4080	Bowker's Ammo. Bone Fertilizer	2.33	2.00	7 92	6.10		2.16		5.59		8.26	8	13.85	10	16.35	1.91	2	1 72

AVAILABILITY OF NITROGEN IN FERTILIZERS.

Station Number.	BRAND.	Total Nitrogen.	Nitrogen from Ammonia Salts.	Nitrogen from Nitrates.	Organic Nitrogen.	Organic Nitrogen soluble in Pepsin solution.	Per cent of Organic Nitrogen soluble in Pepsin solution.	Per cent of total Nitrogen immediately available.
4061	Buffalo Ammo. Bone Superphosphate	3.22	0.19	....	3.03	2.10	69	71
4063	Buffalo Special Superphosphate	2.13	0.24	....	1.89	1.16	61	66
4064	Buffalo New Rival Ammo. Superphosphate	1.51	0.20	....	1.31	0.66	50	57
4066	Lister's Potato Fertilizer	7.32	4.50	....	2.82	2.13	76	91
4067	Lister's Potato Special No. 2	2.40	0.35	....	2.05	1.15	56	63
4068	Soluble Pacific Guano	2.37	0.45	0.25	1 67	1.14	68	78
4069	Cleveland Superphosphate	2.58	0.[illegible]4	0.31	1.83	1.24	68	77
4080	Bowker's Ammo. Bone Fertilizer	2.33	0.09	0.56	1.68	....	....	....

COMPARATIVE VALUE OF FERTILIZERS LICENSED IN 1889 AND 1890.

Of the forty brands of commercial fertilizers sold in the State during the years 1889 and 1890, sixteen standard brands have been selected for a comparison between the character of the goods sold under these brands in each of the two years. Only those brands were selected which have been sold in the State during both of the years.

Average Composition in 1889.

Name of Fertilizing Ingredient.	Pounds in a hundred.	Pounds in a ton.	Price per pound.	Valuation at 1890 prices.
Nitrogen	2.65	53	× 17	$ 9.01
Soluble Phosphoric Acid	7.07	141	× 8	11.28
Reverted Phosphoric Acid	2.90	59	× 7½	4.43
Insoluble Phosphoric Acid	2.45	49	× 3	1.47
Available Phosphoric Acid	10.02	200		
Total Phosphoric Acid	12.47	249		
Potash	3.01	62	× 4½	2.71
Total valuation per ton				$28.90

Average Composition in 1890.

Name of Fertilizing Ingredient.	Pounds in a hundred.	Pounds in a ton.	Price per pound.	Valuation at 1890 prices.
Nitrogen	2.46	49	× 17	$8.33
Soluble Phosphoric Acid	6.18	124	× 8	9.92
Reverted Phosphoric Acid	3.04	61	× 7½	4.57
Insoluble Phosphoric Acid	2.52	50	× 3	1.50
Available Phosphoric Acid	9.22	184		
Total Phosphoric Acid	11.74	235		
Potash	3.05	61	× 4½	2.74
Total valuation per ton				$27.06

From these tables it will be seen that the quality of the fertilizers sold has changed quite decidedly during the past year. Notwithstanding the fact that the price of materials furnishing nitrogen has decreased so that the valuation has been lowered from 19 cents a pound to 17, yet fertilizer manufacturers have decreased the amount of nitrogen in their goods by $0.68 per ton. At the same time, though there has been no change in the price of materials containing phosphoric acid, the amount of it in the fertilizers has dropped $1.20. Potash has remained the same in price and amount. On the whole, therefore, these sixteen brands of fertilizers, which constitute the great bulk of all the fertilizers in the State, have a valuation this year of $1.84 less than last, when calculated on the same prices. But since the selling price in Vermont averages about twenty-five per cent. above the valuation, it follows that this amount should be added to the difference in valuation to get the real difference in commercial value, and this gives $2.30. That is, in order that the farmer may get the same return for his money, he should purchase his fertilizers for $2.30 per ton cheaper than he did last year. There has been no fall in retail price corresponding to this decrease in quality. The decrease in price on these sixteen brands has been $0.88. This means then that while the cost of the raw materials to the manufacturers has decreased, yet these manufacturers have so lowered the quality of their goods as to make the farmer pay about a dollar and a half more per ton than last year for the same amount of plant food. This amounts to $6,000 on the fertilizer business of this State.

Analyses of Miscellaneous Fertilizing Materials not Sampled by the Station.

No. 4006. BOWKER'S HILL AND DRILL PHOSPHATE.

Sent by C. E. Flanders, Proctorsville, Vt., because it had been in a building that was burned.

The following report was made:

" Nitrogen	2.12	per cent
Soluble Phosphoric Acid	3.08	" "
Reverted " "	5.44	" "
Insoluble " "	5.42	" "
Available " "	8.52	" "
Total " "	15.94	" "
Potash	1.62	" "

There is no nitrate left in the sample, although most of the shipments of this brand in 1889 contained considerable of it. It will be noticed that the principal loss has occurred in the nitrogen of which about one-third has gone off. Some of the Soluble Phosphoric Acid has gone into the Reverted and possibly some into Insoluble form. I should judge from the analysis that the sample is worth from three to four dollars less per ton in its present form, than it was when it was sent from the manufactory."

No. 4065. BONE MEAL.

Sent by the manufacturers, the Crocker Chemical and Fertilizer Co., Buffalo, N. Y.

Total Phosphoric Acid	23.89	per cent.
Total Nitrogen	3.40	" "

No. 4097.

Sent by F. Chaffee, Rutland.

Total Phosphoric Acid	23.75	per cent.
Total Nitrogen	3.62	" "

ASHES.

Station No.	Name.	Source.
4092	Lime Kiln Ashes,	C. A. Crampton, St. Albans.
4096	Unleached Ashes,	Seth T. Allen, W. Townshend.
4100	Ashes,	F. Barrett, Underhill.
4101	Unleached Ashes,	S. D. Whitney, Johnson.

ANALYSIS.

Station No.	Potash.			Phosphoric Acid.	Lime.
	Soluble in Water.	Insoluble in Water.	Total.		
4092	3.87	2.55	6.42	1.37	49.65
4096	5.80	0.35	6.15	1.68	
4100	3.94				
4101	8.12				

Remarks. No. 4092, "Good average quality." No. 4096, "Fairly good sample." No. 4101, "Very rich, as high in soluble potash as any sample hitherto analyzed at this station."

No. 4086. FLORIDA PHOSPHATE ROCK.

Sent by J. L. Buttolph, Middlebury.

Total Phosphoric Acid....................20.00 per cent.

REFUSE PRODUCTS FROM WOOL CLEANING.

Sent by Burlington Woolen Mill, Winooski.

Station Number.	Nitrogen.	Potash.
500	18.36	4.04
4,003	3.82	
4,005	0.96	

No. 4059. PEAT.

Sent by Elias Lyman, Burlington.

Water, 5.26 per cent.
Dry Matter, 94.74 "

Dry matter contained 1.62 per cent nitrogen.

The sample was not good for fuel, since it was more than half mineral matter.

No. 4081. MUCK.

Sent by T. H. Wheatley, Brookfield.

Nitrogen in dry matter, 2.13 per cent.

Nos. 4084–5. ROCK.

Sent by B. F. Smith, Waterbury.

The rocks were supposed to contain potash, and analysis showed:

No. 4,084.—1.83 per cent potash.
No. 4,085.—1.14 " "

No. 4099. NITRATE OF SODA.

Sent by F. Chaffee, Rutland.

Nitrogen, 15.98 per cent.

"Good sample."

No. 4098. MURIATE OF POTASH.

Sent by F. Chaffee, Rutland.

Potash, 55.37 per cent.

"This sample is extra highgrade."

Nos. 4082–3. LAND PLASTER.

Sent by C. F. Merrill, Bennington.

The reply sent him was as follows:

"The two samples of " Land Plaster " received and analyzed.

No. I is an impure land plaster, *i. e.* sulphate of lime, containing

81.07	per cent	sulphate of lime, *i. e.* land plaster.
15.43	"	carbonate of lime, *i. e.* limestone.
3.50	"	insoluble matter.

No. II contains

87.28	per cent	carbonate of lime, *i. e.* limestone.
10.90	"	insoluble matter.
1.82	"	undetermined.

The second sample is therefore not a land plaster, but is ground limestone rock. Neither have any value as a fertilizer in the sense that a commercial phosphate has, but both have uses in the soil, and they are of about equal value to mix with Paris green for potato bugs."

ANALYSES OF DRINKING WATER.

1679. Well water from Chas. E. Miner, Shelburne, covered well, 22 feet deep in clay soil.
1681. Well water from R. C. Moodie, North Craftsbury.
1682. Well water from C. H. Root, North Craftsbury.
1687. Water from A. C. Place, Richmond.
1688. Water from C. P. Sanderson, West Milton.
1691. Well water from A. Walston, West Milton.
1693. Spring water from A. C. Place, Richmond.
1697. Spring water from X. C. Wheeler, Fairfax.
1699. Spring water from near Malletts Bay, Colchester, sample sent by J. G. Bellrose.
1700. Well water from Geo. Austin, Jericho Centre.
1716. Water from G. M. Moore, Tyson, Vt.
1717. Water, Vermont Farm Machine Co., Bellows Falls.
1720. Well water, J. M. Quimby, Littleton, N. H.
1727. Well water from well of Mr. Douglass, North Craftsbury, sample sent by R. C. Moodie.
1728. Well water from well of Mr. Morris, North Craftsbury, sample sent by R. C. Moodie.

ANALYSES.

Station No.	Parts per Million.		Grains per Gallon.			
	Free Ammonia.	Albumenoid Ammonia.	Total Solids.	Fixed Solids.	Volatile Solids.	Chlorine.
1679	....	....	....	....	....	31.15
1681	9.05	0.70	8.90	....	....	0.50
1682	0.02	0.11	30.80	....	....	1.50
1687	0.053	0.092	23.45	....	....	2.55
1688	0.02	0.08	14.50	6.10	8.40	2.00
1691	0.02	0.045	5.25	....	....	0.10
1693	0.045	0.155	6.48	....	....	0.25
1697	0.00	0.038	29.30	....	....	0.20
1699	0.01	0.03	37.00	....	....	3.48
1700	0.015	0.155	33.60	22.10	11.50	3.45
1716	1.280	0.690	27.90	9.03	18.87	0.70
1717	0.110	0.120	....	....	....	0.40
1720	0.065	0.085	14.10	8.00	6.10	1.15
1727	0.000	0.030	10.85	8.65	2.20	0.45
1728	0.015	0.060	18.73	15.23	3.50	0.65

Generally speaking, inland surface waters are considered unsafe for use if they contain more than 40 grains per gallon of solids, 3 grains per gallon of chlorine, or 0.05 parts per million of free ammonia or 0.15 parts per million of albumenoid ammonia.

Analyses of samples of water from the present and from prospective sources of supply of the City of Burlington.

1683. Brown's River, April 7, 1890.

1684. Sewerage, April 7, 1890.

1685. Broad Lake, April 7, 1890.

1686. Service Supply, April 8, 1890.

1689. Brown's River, April 30, 1890.

1694. Tap water from lower service, June 3, 1890.

1695. Pumping Station, June 3, 1890.

1696. Sewerage, June 3, 1890.

1735. Old Reservoir, January, 1891.

1736. New Reservoir, January, 1891.

ANALYSES.

Station Number.	Parts per Million.					
	Free Ammonia.	Albumenoid Ammonia.	Total Solids.	Fixed Solids.	Volatile Solids.	Chlorine.
1683	0.08	0.14	63.0	39.0	24.0	4.3
1684	1.76	0.35	337.6	250.0	87.6	23.0
1685	0.015	0.17	41.1	14.0	27.1	3.2
1686	0.02	0.115	69.3	36.4	32.9	4.3
1689	0.035	0.08	51.0	18.4	32.6	3.2
1694	0.010	0.095	75.0	56.0	19.0	3.3
1695	0.020	0.105	76.5	56.5	20.0	2.5
1696	1.875	2.015	160.0	48.5	111.5	15.7
1735	0.000	0.080	----	----	----	----
1736	0.000	0.095	----	----	----	----

ABSTRACTS OF BULLETINS.

Owing to lack of space it is not deemed advisable to reprint in full the bulletins published during the year. Some of the more important conclusions are here given, and those who wish the full accounts can obtain them by applying to the Station for the bulletins in which they appeared.

BULLETIN No. 18.

PIG FEEDING.

HISTORY.

Two pure-blooded Chester White pigs, a sow and a barrow, were obtained from the Vermont State Prison at Windsor; two small Yorkshire pigs and two Berkshire, a sow and a barrow of each, were bought of L. S. Drew, Burlington. These pigs were all within two days of five weeks old on the day they were put in our pens, May 14, 1889. At first, owing to lack of room, the two pigs of a breed were kept in the same pen, and one-half the feed given to the pen credited to each pig. On July 9, the new piggery was completed and each pig assigned a separate, roomy pen, in what we think is one of the best piggeries in the State. The intention was to feed all the pigs on the same ration, but they grew at such different rates that it became necessary to modify the plan and substitute the feeding of the pigs the same when they weighed the same. For example: the Berkshires were a little heavier than the Yorkshires, and what the Berkshires had for their ration during one period, when they weighed say 100 lbs., would be the ration for the Yorkshires the next when they had reached that weight.

The pigs were weighed separately about once in ten days, and the rations were increased from time to time as the pigs increased in weight.

The materials fed were skimmilk, cornmeal and bran, six quarts of skimmilk being fed to each pig daily, and the grain ration increasing as the pigs grew older, from twelve ounces of cornmeal daily when they weighed about fifty pounds apiece, to fifty-four ounces of corn meal and twenty-eight ounces of bran daily as the largest amount fed.

The experiment lasted from May 14 to November 11, and the time can be divided into four periods, as follows:

Period.	Date.	Average Live Weight at end of the Period. Lbs.
I	May 14—July 9.	62
II	July 9—August 12.	96
III	August 12—September 23.	155
IV	September 23—November 11.	208

If pigs are well kept they should gain faster the older they grow. This was the case with these pigs.

Period.	Average Gain in Live Weight per day for all six pigs.
I	0.75
II	1.07
III	1.33
IV	1.42

This must not be taken to show that pigs are more profitable the older they grow; the opposite is the truth. They do grow faster, but they eat so much larger rations, that the extra gain is more than offset by the extra cost. This is shown in the tables which follow.

The corn meal used was bought at $18.00 per ton, and $16.00 per ton was paid for the bran. The skimmilk was from our own dairy, and has been considered worth 15 cents per 100 pounds, or 1¼ cents per gallon. These prices were used in calculating the cost of the feed consumed by the pigs.

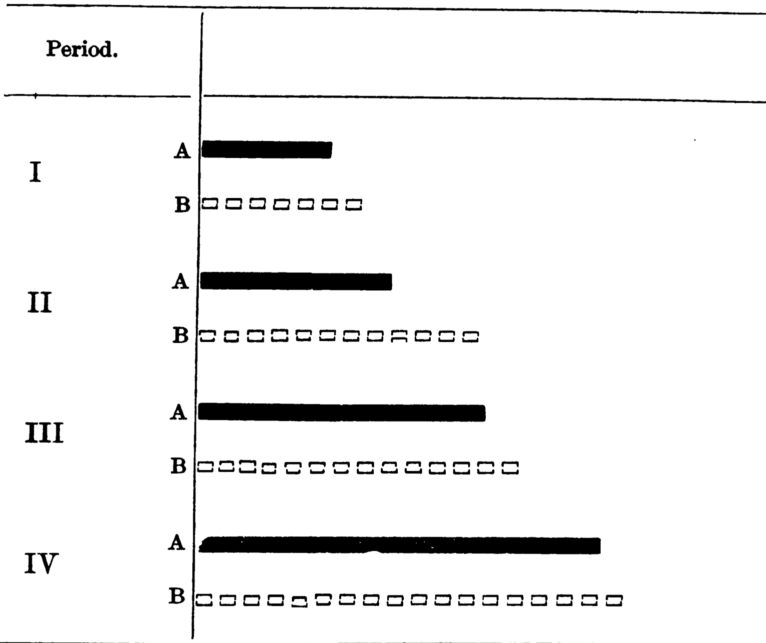
The most important lesson to be learned from these tests is that the cost of producing a pound of gain in live weight increases very rapidly as the pig grows older. This is shown plainly in the following table:

COST OF GAIN, COMPARED WITH LIVE WEIGHT.

Period.	Average weight at the end of the period. lbs.	Average amount of dry matter in food consumed for each pound increase in live weight. lbs.	Average cost of feed consumed for each pound increase in live weight. cents.
I	62	1.34	2.01
II	96	2.50	3.07
III	155	3.09	3.54
IV	208	3.91	4.38

RELATION OF WEIGHT AND FEED.

This can be indicated to the eye in the form below, in which the line A represents the average weight of the pigs at the end of each period (one inch of length being equal to 100 pounds weight), and the line B represents the cost of the feed that was eaten by the pigs during that period for each pound of gain in live weight (one inch in length representing 2 cents value of food.) It will be noticed that as the lines indicating weight increase in length showing that the pigs are becoming heavier, the lines representing cost of a pound of gain also grow longer, showing that the larger the pig, the more it costs to make a pound of pork and the less profitable the pig becomes.



Out of the food given to the pig, the animal first takes enough to support life, and the surplus, if any, goes to form growth. The more pounds the pig weighs, the more food is required to support life. In the last period there were more than three times as many pounds of live pig to be nourished as in the first period, and consequently a much smaller proportion of the food left for the production of growth. The question naturally arises, then, as to how long the pig can be kept before the cost of keeping him alive will be equal to the value of the increase in live weight and the animal cease to give a profit to its owner. This will depend somewhat on the market price of pork. If pork is high it will be profitable to keep the pigs longer and grow them to a greater weight than if the price of pork is low. This question can be answered for the pigs now under discussion, for we

have all the data bearing on the subject. They were sold at 5¼c. per pound dressed weight. This is lower than the average price through the year, and if they have paid a profit at this price, farmers generally ought to find pig raising profitable.

FINANCIAL SUMMARY.

BREED.	Live weight.	Dressed weight.	Per cent of shrinkage in dressing.	Selling price per pound of live weight in cents.	Pounds of live weight gained during test.	Selling price of live weight gained during test.	Cost of feed consumed.	Gain.
Berkshire No. I	220	183	17	4.36	205.0	$8 94	$6 70	$2 24
Berkshire No. II	203	168	17	4.36	188.5	8 22	6 70	1 52
Chester White No. I	233	186	20	4.20	205.5	8 63	6 02	2 61
Chester White No. II	172	139	19	4.25	144.5	6 14	4 48	1 66
Yorkshire No. I	208	175	16	4.41	188.0	8 29	6 16	2 13
Yorkshire No. II	175	145	17	4.36	157.0	6 85	6 16	0 69
Total	1211	996	18	4.32	1088.5	47 07	36 22	10 85

This shows that the pigs as a whole yielded a profit, but if this profit is analyzed by periods it will be found that most of it was made in the early periods.

NET GAIN PER POUND BY PERIODS.

Period.	Average weight at the end of the period.	Average cost of feed consumed to each pound increase in live weight.	Average selling price per pound live weight.	Average gain per pound increase in live weight.	Total gain during period.
	lbs.	Cts.	Cts.	Cts.	
I	62	2.01	4.32	2.31	$5 77
II	96	3.07	4.32	1.25	2 55
III	155	3.54	4.32	0.78	2 76
IV	208	4.38	4.32	0.06*	0 19*

* Loss.

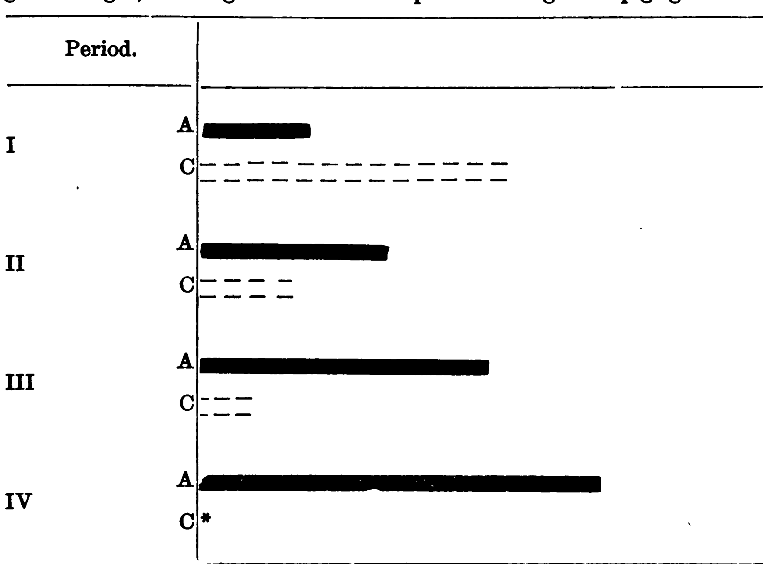
RESULT OBTAINED FROM FEEDING 100 POUNDS DRY MATTER PER PERIOD.

Period.	Pounds Gain in Live Weight.	Excess of Selling Price Over Cost of Feed.
I	75	$1 73
II	40	0 50
III	32	0 25
IV	26	0 02*

* Loss.

RELATION OF WEIGHT AND PROFIT.

The same thing may be shown in diagram by supposing the line A to represent the average weight of the pig at the end of the period (one inch — 100 pounds weight) and the line C to represent the amount of profit that was obtained for each 100 pounds of dry matter fed during the period (one inch represents $1.00 of profit). This line C grows shorter as the line A grows longer, showing that there is less profit the larger the pigs grow.



* Loss.

The answer is here shown to the question as to the most profitable time to market pigs. At an average live weight of 155 pounds, the pigs were still yielding a profit above the cost of their feed. This profit had ceased when they weighed 208 pounds. It can be said then that the experiment shows conclusively that in the case of these pigs, under the best of care, there was no profit in keeping them after they weighed 200 pounds apiece, and it would have been more profitable to sell them at about 175 to 180 pounds weight, and feed what they consumed during the last week of their life to younger pigs.

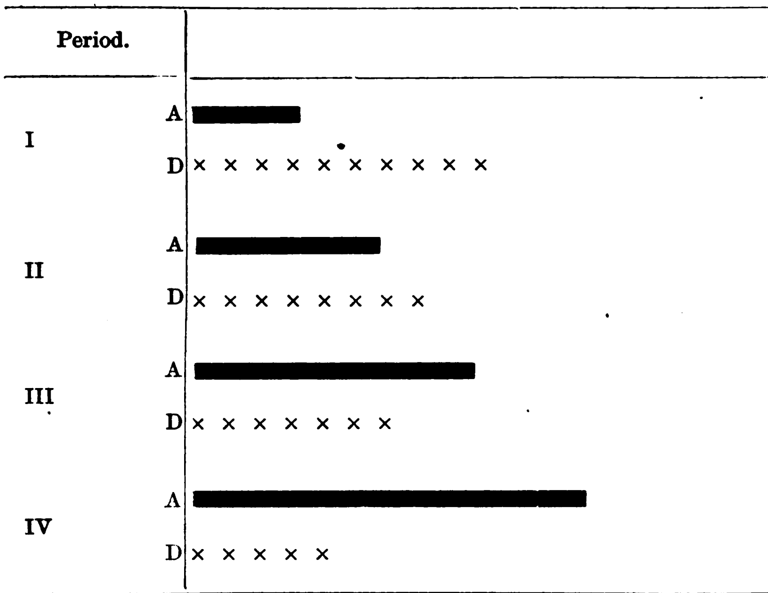
VALUE OF SKIMMILK.

The price of 15c. per 100 pounds has been assigned to skimmilk. It will be interesting to calculate its value in another way. If we suppose the manure to offset the care, and substract from the amount received for the pork, the amount paid for the grain fed, the remainder may be considered the amount realized for the skimmilk.

Period.	Amount realized from skimmilk per 100 pounds per period.
I	32c
II	25
III	23
IV	14
Average.	24c

RELATION OF WEIGHT AND VALUE OF SKIM MILK.

The relation of the weight of the animals to the profit obtained from feeding skimmilk during the different periods is diagramed below, in which A is the weight of the pig, and D is the amount received for each 100 pounds of skimmilk fed to the pigs during the period. As the lines indicating weight increase in length the lines D representing profit decrease, showing that it is more profitable to feed skimmilk to young pigs than to those of a larger weight.



FERTILIZING VALUE OF FEED.

So far no attention has been given to the fertilizing value of the food consumed. This is an important item in all stock-feeding, and with many farmers is one of the principal reasons why stock is kept. The assumption is made in the following calculations that twenty per cent of the fertilizing ingredients of the food, nitrogen, phosphoric acid and potash, are taken out by the pig for the production of growth, and that the rest is saved without loss by the farmer. Nitrogen is valued at 17 cents per lb., phosphoric acid at 6 cents, and potash at 4½ cents. These prices are twenty-five per cent lower than the ingredients cost in commercial fertilizers in Vermont, and this may be considered to just balance the loss of fertilizing matter in feeding.

COMPOSITION OF FEED IN POUNDS PER TON.

	Nitrogen.	Phosphoric Acid.	Potash.	Valuation.
Skimmilk	11.0	4.10	4.2	$ 2.29
Corn meal	29.0	12. 8	8.0	6.04
Wheat bran	49.7	60. 7	31.3	13.42

FERTILIZING INGREDIENTS IN FEED CONSUMED.

	Berkshire No. I.	Berkshire No. II.	Chester White No. I.	Chester White No. II.	Yorkshire No. I.	Yorkshire No. II.
Nitrogen, lbs	18.62	18.62	16·80	12.99	17.52	17.52
Phosphoric Acid, lbs.	10.53	10.53	9.42	7.11	9.90	9.90
Potash, lbs	8.01	8.01	7.20	5.60	7.56	7.56
Valuation	$4.14	$4.14	$3.73	$2.87	$3.89	$3.89

Total fertilizing value of feed $22.66.

This value should be substracted from the cost of feed eaten to get the net cost of raising the pork.

Gross cost of feed consumed per pound increase in live weight........3.33c.
Value of fertilizing ingredients in food.................................2.08 "
Net cost of pork per pound live weight...................................1.25 "
Gross cost per pound of dressed weight...................................4.06 "
Fertilizing value of food..2.54 "
Net cost of pork per pound dressed weight...............................1.52 "

BULLETIN NO. 21.

TESTING MILK AT CREAMERIES AND CHEESE FACTORIES.

REASONS FOR TESTING MILK.

No creamery man or set of creamery patrons will be willing to go to the trouble and expense of having their milk tested and of paying or being paid according to the amount of butter fat it contains until they are convinced that there is necessity for it. At present in most creameries the milk is paid for according to its weight. No one has ever claimed that this is a correct method of paying for milk, because all agree that milk is variable in its character. But few realize how wide the variations are, and how much injury is done when all milk is treated alike. This injury comes from three sources: the injustice, the bad results in breeding and the moral tendencies.

Injustice.—It is not right or fair to pay the same amount for rich milk as for thin milk. The actual variation in milk is quite large. A single example will suffice to show this. One of our chemists was sent to a creamery in Franklin county where he sampled and analyzed the milk delivered one day by each patron. The creamery at the time was paying sixty cents a hundred for all the milk it received. If the milk had been paid for according to its real butter value the various patrons would have received as follows, per hundred, for their milk:

No. of Sample.	Milk. Lbs.	Fat. Per Cent.	Value of Milk Per 100 Lbs.
1	94	4.23	65c
2	354	3.91	60
3	494	3.73	58
4	527	3.85	59
5	491	4.00	63
6	548	3.98	61
7	329	3.91	60
8	158	3.79	59
9	550	3.85	59
10	258	3.98	61
11	278	3.54	55
12	399	3.85	59
13	188	4.10	63
14	117	3.91	60
15	91	3.73	58
16	109	4.10	63
17	96	3.35	52
18	264	3.91	60
19	707	3.60	56
20	317	3.60	56
21	112	4.10	63
22	159	4.04	61
23	441	4.35	66
24	277	3.54	55
25	270	4.91	74
26	345	3.60	56
27	525	4.10	63

Here is a variation from 3.35 per cent of fat to 4.91 per cent, or from milk worth 52 cents a hundred to that worth 74 cents, *i. e.*, 100 pounds of the richest milk is worth 142 pounds of the poorest. It is only common justice that a man should be paid for what he delivers, and that if he delivers poor milk he should be paid for it and should not receive as much as the man who delivers good milk.

Bad Tendency in Breeding.—The water that is in milk has no value as a food, and is of no value for butter making or for cheese making, hence it should not be taken into account in paying for the milk. The efforts of the breeder should be directed toward the rearing of animals that will pro-

duce the most butter or the most cheese for the amount of food consumed. A careful study of the herds of this State will show the evil effects of the present method of paying for milk. Wherever in this State a cheese factory has been run for many years it will be found that the herds in that vicinity all give thin milk and will produce but a small number of pounds of butter a year. The reason of this is evident. The patrons have been paid entirely by the weight of their milk, and so all their efforts in breeding have been directed to getting cows that would give the largest quantity of milk without regard to its quality, and as a large flow of milk is almost always accompanied with a poor quality of milk the natural result is that the general character of the milk of the neighborhood is lowered. But the evil goes farther than this. Cows that give this large flow of milk that is watery usually dry up quickly, and there will be found all through this State, in the vicinity of cheese factories, herds of cows of large form, large udders, large consumers of food, that give a large flow of thin milk during May and June, and are pretty well dried up by October, so that the total amount of milk produced per cow per year is less than three thousand pounds, and the total butter which this milk will make is scarcely more than a hundred pounds. On the contrary, the best herds in the State will be found where the product of the herd has been used at home in making butter, and the breeding has been with the view of getting the cow that would make the most butter per year on moderate food. The introduction of a testing machine into the creamery and cheese factory will furnish all the dairies with an incentive to breeding for quality as well as quantity, and this one thing would, in ten years, work almost a revolution in the character of the cows in this State.

Moreover it might be stated here that there are now on the market machines for analyzing milk that are so easy and cheap that it would be *a very simple matter for each patron of the creamery or cheese factory to bring to the factory samples of milk of his individual cows and learn which were good cows and which ones should be discarded. In this way a single machine at a central point would be sufficient to test the milk of several hundred cows. Any one can see at once what an immense stride Vermont dairying would make under these conditions.*

Moral Effect.—Few have an idea of the amount of doctoring of milk there is done in this State. Where the milk is paid for according to weight a premium is put on the watering or skimming of milk. Human nature is not proof against this temptation, and as a result we have found samples of milk that had been tampered with in every one of the more than twenty creameries that we have tested. The paying for milk according to its real value does away with all temptation for cheating and has a beneficial effect on the moral atmosphere of the neighborhood. Two illustrations of this have come to notice this summer. In one case a creamery decided to adopt

paying for milk according to test, and the quality of the milk became better at once, even before the test was put in. In the second case, one of our chemists drew samples for four consecutive days at a certain creamery, and although the quantity of the milk remained constant during those four days, its quality steadily increased until the fourth day as compared with the first, it took a pound and a half less of milk to make a pound of butter.

METHODS OF SAMPLING.

One of the most difficult parts of the correct analysis in milk is the getting of a correct sample. This is much more difficult than most creamery men are willing to believe, and few can be induced to do more than take up a dipper full just after the milk is poured into the weighing can. To these faulty methods of sampling is due much of the troubles that have arisen in creameries that have been paying by test.

The most reliable method of sampling is by the use of a sampling tube which takes out a core of milk from the top to the bottom. This sampling tube can be made by any ordinary tin-smith by taking a piece of brass tubing an inch in diameter, running a wire through the length of it, terminating at the upper part in a bend for handle, the other end of the wire being soldered into a firm sheet of iron which is covered on its upper surface by a piece of rubber packing. This iron valve should be a trifle larger than the size of the tubing. The wire is held in the centre of the tube by a small wire loop at the top and bottom, near the ends of the tube. By pushing down on the handle the valve is carried away from the bottom of the tube leaving a place for the milk to enter. While in this position the tube is pushed down vertically into the milk in the weighing can until it reaches the bottom. The wire is then pulled up, closing the bottom of the tube taking with it a core of milk from the top to the bottom of the can. The bottom of the tube is put into the can or jar in which the sample is to be kept, and by loosening the valve the milk is allowed to flow out. Three such samples will furnish enough milk for a sample for analysis, and will give a sample that is a correct average of all the milk. But even when using this it is advisable to stir the milk well with a dipper before taking the sample. Of course if the amount of milk is small, one hundred to two hundred pounds, and it is stirred very thoroughly with a large dipper, it can be mixed so thoroughly that a correct sample may be taken out with a dipper. Care must always be used in taking a sample, and it is always advisable to use a good deal more care and pains than it seems possible can be needed. By using sufficient care it is possible to sample a large amount of milk, two thousand pounds, for instance, and get several different samples that shall not vary in composition more than one-tenth of one per cent. If, then, the creamery man finds that his samples do not agree with each other he can be reasonably sure that the trouble is with himself and that he does not use enough care in taking the sample.

HOW OFTEN SHALL SAMPLES BE TAKEN.

An important question to be decided at any creamery, where it is intended to pay according to the amount of butter fat delivered, is, how often shall the milk be analyzed. To be absolutely correct, the milk should be analyzed every day, but the quality of the milk is not variable enough to make this necessary. The analysis should be, however, frequent enough to give the correct character of the milk and also to discourage any tampering with the milk on the part of the patrons. This often happens where the samples are taken but once a month, since the patron can be reasonably sure that for the next few days after the monthly sample has been taken out, he can doctor his milk without being discovered. *Four times a month* if sufficiently often for analyzing. But by adopting the methods of sampling that we use at this Station, it is possible to make these four analyses represent much more than four days out of the month. In all our experimental work at the Station we take samples of milk from several milkings. mix them together, and make one analysis of the mixed sample,in this way getting the average character of the milk from the several milkings. By the use of chemicals it is possible to retain the milk for several days in a good condition for analysis.

METHOD OF SAMPLING RECOMMENDED.

Have a pint glass fruit can of the lightning jar pattern for each patron of the creamery; these jars to be permanently numbered with metal labels wired to the jar, and each patron to have a number corresponding to the one on the jar. In the bottom of each of these jars, put one-twentieth of an ounce of powdered corrosive sublimate, to which has been added one one-hundreth of its weight of acid magenta, or any other of the aniline colors, that would not be destroyed under the conditions present. In this way any milk which has the poisonous corrosive sublimate in it will have such a vivid pink color that there will be no danger of any one drinking it by mistake or of its being fed to animals. Any day in the week a correct sample of the milk measuring one-fourth of a pint taken either by a sampling tube or a dipper is put into this jar. Any other day in the week a second sample of the same size and taken in the same way should be added, if great accuracy is desired. The patron should not know beforehand what day these samples are to be taken,and they need not be taken the same day for all the patrons. The cans can be prepared Saturday morning and samples taken any day during the week, so that the patron can never be sure when he brings his milk whether or not a sample is to be taken from that day's milk. At the end of the week the mixed sample is analyzed and its analysis considered to represent the average character of the milk delivered during the week. Three samples would *certainly* be enough to represent the average character of the milk for any one week, and two

samples a week, taken each week for a month, would *certainly* be enough to correctly represent the average character of the milk for the month. This amount of corrosive sublimate will keep the milk for ten days in the hottest weather, and does not interfere with the accuracy of the analysis, by the ordinary methods now in use at creameries. But corrosive sublimate cannot be used for preserving the sample when any of the methods of extracting the fat by ether is used.

When corrosive sublimate is added to samples, and those samples are held for several days in a warm room, it is necessary to be quite careful in the handling of the milk to prevent its churning. The samples cannot be carried from one place to another by team or on the railroad without danger of their churning, and even the mixing should be done with care and done entirely by pouring instead of by shaking.

SIZE OF SAMPLE.

In the above instructions it has been stated that the sample taken different days from the same dairies should always be of the same size, about one-fourth pint, and this holds true whether the milk brought is one hundred pounds or a thousand pounds. Theoretically this is not correct, and by some people great stress has been laid on the necessity of taking a sample of variable size to agree with the quantity of milk delivered. Thus, if one man delivers two hundred pounds and another man a thousand, one sample should be five times as large as the other. It has been stated that there is a creamery in Iowa, whose managers are careful to follow this plan and vary the size of the sample drawn each day as the quantity of the milk varies. For more than two years our station has been analyzing mixed samples, and we have always taken out the same size of sample whether the quantity of milk was large or small. It is a great deal easier to use always the same cup and take the same size of sample from each man's milk, than to bother to take a different amount each time and to take that amount just proportional to the amount of milk delivered. If it can be shown that our method of sampling introduces an error that is too small to affect the results, then it is certainly better to take our simple method, rather than the other cumbersome one. To test this point we made an extensive series of analyses.

Samples were taken at a creamery of each patron's milk for four consecutive days, and each analyzed separately each day. This gives a basis for calculating the results that would be obtained by the two methods of taking samples. For example: Mr. A. brings 310 lbs., 400, 360 and 380 lbs. for the four days, analyzing for each day separately 3.75, 3.20, 3.95 and 4.10 per cent of fat, respectively. Mr. A therefore furnished $310 \times 375 =$ 11.63 lbs. fat; $400 \times 320 = 12.80$ lbs; $3.60 \times 395 = 14.22$ lbs.; and $380. \times 410 = 15.58$ lbs. in all, 54.23 lbs. butter fat. This 54.23 lbs. is what Mr. A

actually brings. Now let us see how much out of the way the results would be by our method of sampling. If the samples of milk taken were all of the same size, the resulting sample would analyze the same as the average of the four single samples. The average of 3.75, 3.20, 3.95 and 4.10 is 3.75. The total milk brought was 1,450 lbs., which multiplied by 3.75 gives 54.37 lbs. fat. The difference between 54.37 and 54.23 is 0.13 lbs. fat. *i. e*, the difference between our method and the truth in this case, is 0.14 lbs. butter fat, which difference or error is less than the error that is made every time the whole milk is weighed and is ten times less than the probable error when the milk is analyzed. In other words, the error introduced into the work by taking all the samples of the same size is much too small to be of any account. In this same way we have calculated the error for each of the patrons of the creamery for these four days during which the amounts of milk were quite variable, and the per cent of fat exhibited some remarkable changes (due we suppose to the moral effect on the patrons of the presence of our chemist at the creamery.)

The following table shows the results; the first column giving the actual amount of butter fat in the milk, and the second column the result obtained by multiplying the total weight of milk by the average of the four analyses of each day separately, which is of course the same result as would be obtained by analyzing a mixture of equal sized samples from each day's milk:

	Butter Fat Brought to the Factory. lbs.	Butter Fat Found if Samples were all Same Size. lbs.	Difference. lbs.
1	6.98	6.97	0.01
2	47.01	47.02	0.01
3	3.08	3.00	0.08
4	22.25	22.23	0.02
5	101.29	101.36	0.07
6	73.84	73.78	0.06
7	180.99	180.96	0.03
8	107.23	107.27	0.04
9	22.90	22.93	0.03
10	22.57	22.59	0.02
11	118.20	118.57	0.37
12	75.75	75.77	0.02
13	39.23	39.25	0.02
14	113.43	113.36	0.07
15	57.99	58.02	0.03
16	110.95	110.28	0.67
17	61.61	61.58	0.03
18	62.93	63.04	0.11

The average of these differences is less than a tenth of a pound of butter fat in four days; had the samples been taken for seven days the differences would have been still smaller. The largest difference is two-thirds of a pound, and this is on a large lot of over a hundred pounds of butter fat.

In the light of these results it is evident that the taking of samples for analysis that vary in size with the quantity of milk, is a needless precaution, and that in actual practice it is better to have a single sampling cup for all the work.

VARIATIONS OF TESTS.

Complaint often comes to us from patrons of creameries, who say that their tests are uneven; one month, for instance, running 4.50 per cent of fat, and the next only 3.50, and they want to know if it is possible for their cows to actually vary that much in a month. The answer of course must be, that the milk from a herd of cows does not vary much.

Any such result, unless it is in a small herd or a herd which has changed largely in the character of its individual cows, shows that there has been error either in sampling or analyzing, or else it shows that the samples were not taken often enough during the month. It is possible to find single day's milk from a herd of twenty cows in one month that will contain one per cent of fat more than the milk of some other single day in another month; in fact, we have had cases arise in our own work this summer in which there was a variation of nearly two per cent. But when the cows of the herd have remained the same during the time, it is not possible to find the average of six to twelve day's milk taken at random during the month, varying a whole per cent over the same number of days taken in a month before or after. Such monthly figures will seldom vary as much as a half of one per cent, but there will be a gradual increase in quality from the time the cows go out to pasture until they go to the barn for winter.

RELATION OF BUTTER FAT TO BUTTER.

The question is constantly being asked, what relation the butter fat in the milk as brought to the creamery bears to the amount of butter that will be produced from it? No definite answer can be given to this question, because the amount is quite variable, depending upon the skill of the butter maker, the character of the tools he uses and the time of year. The figures presented in Bulletin 16, of this Station, show that the amount of butter made from one hundred pounds of butter fat in the original milk, varies from one hundred and five pounds to one hundred and fifteen, with an average of one hundred and eight. This average of one hundred and eight is quite close to the general run of work done in the better creameries of the State, and where it is not known definitely what the relation is will do well enough for an approximation. But the only correct way of

ascertaining the relation, is for each creamery to calculate it from its own records. At the end of the month figure up how much butter fat has been actually delivered by the patrons, and how much butter has been made. Divide the latter by the former, and the result will be the pounds of butter made for each pound of butter fat delivered. This calculation will be necessary in all creameries where the patrons are paid according to the amount of butter produced, instead of according to the amount of milk or butter fat delivered. In this connection we would refer again to Bulletin No. 16, of this Station, where this whole subject is treated. This bulletin will be sent free of charge to any one on application. The tables given there to aid in calculating the value of milk according to its analysis have been published on sheets of cardboard, and will be furnished to any creameries and cheese factories which desire to use them.

CREAM-GATHERING CREAMERIES.

The methods of testing milk can be applied as well to a cream-gathering creamery as to a whole milk factory. The only difference is, it will be necessary to have the cream gatherer take the samples while he is on his rounds instead of waiting until the cream reaches the factory.

Taking samples of cream is much more difficult than taking samples of whole milk. The cream gatherer would have to be especially careful in this part of the work. It would be necessary to pour the cream back and forth several times and take the sample quickly. When the creamery man comes to analyze the sample he will have to be careful to do all the mixing of it by pouring instead of by shaking, since when the cream is shaken it takes up a large number of air bubbles that stay in it a long time and pass up with the cream into the pipette, and do not allow the full amount of cream to be measured.

CHEESE FACTORIES.

In all the writing that has been set before the public regarding the testing of milk, reference has been had almost entirely to the testing of milk at creameries. It seems to have been thought that it was not possible for cheese factories to apply this test to the paying for milk according to the per cent of fat it contains. The reason for this is evident. In the creameries the fat is the only part that is used, whereas in the cheese factories both the fat and the casein pass into the cheese to form part of its value. It will be found, however, on investigation, that this does not express the whole truth, but that the value of the milk for cheese making depends so largely on the per cent of fat present, that it would be nearly correct to pay for milk at the cheese factories according to the per cent of fat it contains. In general, it is true that the more fat the milk contains the more casein it also contains, so that the amount of cheese to be made

out of the milk can be very accurately gauged by the amount of fat it contains. It is also true that the market value of the cheese comes almost entirely from the fat. Cheese that would sell for ten cents a pound if made from the whole milk would fall in price to two cents, one cent, or possibly in some places to not more than half a cent a pound, if the fat was taken out of the whole milk before it was made into cheese. It is evident, then, that the fat in the milk determines both the quality and the market value to so large an extent that it would be just to all concerned to pay for the milk at cheese factories largely according to the per cent of fat it contains.

But it will hardly do to make this rule invariable. It is not a fact that twice as much cheese can be made from milk containing six per cent of fat as from milk containing three per cent. A method to be just to all must take into account both the casein and the fat. This can be arrived at quite closely by paying a certain amount for the milk by weight, without regard to its quality, and a certain amount additional for each pound of butter fat it contains. Thus, if 30 cents a hundred is paid for all milk, and 10 cents a pound for butter fat, a three per cent milk would receive $30 + 3 \times 10 = 60$ cents a hundred, a four per cent milk 70 cents, and a six per cent milk 90 cents. This is quite close to what has been paid for milk at the cheese factories this summer.

In most factories the proprietor makes the cheese for so much a pound, and the patrons get what is left from the proceeds of the sale of the cheese after deducting the cost of the making. Suppose a factory during the season has made one hundred thousand pounds of cheese, which sells for ten cents a pound, and a cent and a half is charged for making, so that it nets the patrons eight and a half cents a pound, or eighty-five hundred dollars for the season. If the milk has been tested from time to time and a record kept of the per cent of fat and the weight of the milk, it will be possible to figure out the total number of pounds of fat that have been delivered at the cheese factory during the season. Suppose this is forty thousand pounds, and also suppose that it has taken ten pounds of milk on the average to make a pound of cheese. The account will stand thus:

Whole number of lbs. of milk	1,000,000
Received net for cheese	$8,500
Paid for milk at 30c per 100 lbs	$3,000
Balance to be paid for butter fat	$5,500
Pounds of butter fat delivered	40,000
Price to be paid for each pound butter fat ($5,500 ÷ 40,000)	11.7c

Mr. A. during the season brings 30,000 lbs of milk that averages four per cent fat. His account will stand:

30,000 lbs. milk at 30c per 100	$ 90 00
30,000 lbs. of 4 per cent milk contains 1,200 lbs. fat.	
1,200 lbs. fat at 11.7c	140 40
Total for the milk	$230 49

BULLETIN No. 22.

TEST OF DAIRY COWS.

HOME VS. FAIR GROUNDS.

The test on the fair grounds at Burlington took place on Thursday, Sept. 4th, 1890, each cow being milked clean the night before, in the presence of a Station officer, the test being based upon the milk yield of the following twenty-four hours. The milks were set in deep cold setting, skimmed in twelve hours and the creams churned sweet at the end of the second skimming. Samples of whole and skim milks of both morning and night yields, of buttermilk and butter, from each cow were taken, and all analyzed by gravimetric methods at the Station laboratory. All samples both at home and at the fair ground were taken by Station officers, and all analytical data given in this bulletin calculated to the milk of the entire twenty-four hours from the analyses and weights of morning and night's milks. Milking and skimming took place at the grounds.

The results of this test are not regular and bovine individuality shows out strongly. None of the six cows tested gave less and poorer milk at the fair ground than at home. One Jersey and one Ayrshire gave more and better, one Jersey and one Ayrshire less and a little better, one Jersey the same and poorer, while the Holstein appeared unaffected. In but one case out of six was quality lowered and in but two cases out of six was quantity materially lowered as a result of the sudden change in location and habit of life.

None of these cows were especially fed in advance by way of preparation for the tests, all having had pasture feed supplemented in some cases with grain. Their feed during the test was more liberal but was not extraordinary. A cow under high feeding pressure is in an unnatural bodily condition and hence more susceptible to outside influences; as none of these cows were thus pressed, less radical changes were to be expected.

A study of the following table will show that the fat was the most inconstant ingredient, that whenever quality or quantity of milk constituents has altered as a result of the change from pasture to fair ground, as a rule the fat has varied more than the other solids. This fact is in line with many other observations indicating that the fat is the most variable ingredient of milk.

Breed.	Name of Animal.		Milk Yield. lbs.	Total Solids. %	Fat. %	Casein. %	Milk Sugar and Ash. %	Total Solids. oz.	Fat. oz.	Casein. oz.	Milk Sugar and Ash. oz.
Ayrshire.	Dolly Athol, 4th.	At Home, Sept. 2, 1890	26.50	14.55	4.52	4.34	5.69	61.70	19.18	18.40	24.12
		At Ch. Val. Fr. Sept. 4, '90	31.00	15.77	6.67	3.47	5.63	78.21	33.10	17.28	27.88
		Product at Home plus or minus that at Fair	**-4.50**	**-1.22**	+2.15	**+0.87**	**+0.06**	**-16.51**	**-13.92**	**+1.17**	**-3.76**
Jersey.	Creamer.	At Home Sept. 2, 1890	23.06	14.26	4.99	3.56	5.71	52.60	18.41	13.14	21.05
		At Ch. Val. Fr. Sept. 4, '90	24.44	14.98	5.63	3.62	5.68	58.34	21.99	14.17	22.19
		Product at Home plus or minus that at Fair	**-1.38**	**-0.67**	-0.64	**-0.06**	+0.03	**-5 74**	**-3.57**	**-1.03**	**-1.14**
Jersey.	Kinkora.	At Home, Sept. 3, 1890	28.75	13.25	4.27	3.22	5.76	60.94	19.63	14.81	26.50
		At Ch. Val. Fr. Sept. 4, '90	23.13	13.66	4.40	3.23	6.03	50.56	16.28	11.97	22.31
		Product at Home plus or minus that at Fair	**+5 62**	**-0.41**	-0.13	**-0.01**	+0.27	+10 38	**+3.35**	**+2.84**	**+4.19**
Jersey.	Lottie.	At Home Sept. 3, 1890	32.75	12.91	4.47	2.70	5.74	67.66	23.41	14.10	30.16
		At Ch. Val. Fr. Sept. 4, '90	33.07	11.81	3.65	2.65	5.51	62.48	19.32	14.02	29.14
		Product at Home plus or minus that at Fair	**-0.32**	**+1.10**	**+0.82**	**+0.05**	**+0.24**	**+5.18**	**+4 09**	**+0.08**	**+1.02**
Ayrshire.	Frankie, 5th.	At Home, Sept. 2, 1890	20.31	13.30	4.32	3.11	5.87	48.87	14.07	10.18	19.17
		At Ch. Val. Fr. Sept. 4, '90	17.07	13.75	5.04	3.01	5.70	37.54	13.75	8.23	15.55
		Product at Home plus or minus that at Fair	**+3.24**	-0.45	**+0.72**	**+0.10**	**+0.17**	**+5.83**	**+0 32**	**+1.90**	**+3.62**
Holstein.	Dinah.	At Home, Sept. 2, 1890	18.94	12.54	3.94	2.98	5.62	38.01	11.95	9.08	17.03
		At Ch. Val. Fr. Sept. 4, '90	18.63	12.52	4.09	2.94	5.49	37.31	12.19	8.75	16.37
		Product at Home plus or minus that at Fair	**+0.31**	**+0.02**	**-0.15**	**+0.04**	**+0.13**	+0.70	**-0.24**	**+0.28**	**+0.66**

All the cows were more or less disturbed and nervous while at the grounds. The two registered Ayrshires belonging to L. S. Drew of Burlington were particularly affected, being in the language of their owner, "as wild as hawks." Both had the same treatment for months previous and were similiarly treated and fed at the fair, yet one (Frankie 5th) gave less milk of better quality, and less milk ingredients, while the other (Dolly Athol 4th) made a most remarkable increase in butter fat as a result of her nervous condition. Similar cows of the same breed and herd, similiarly treated, under similar circumstances of nervous excitement and apparently similarly affected thereby, actually gave most dissimilar returns at the milk pail.

The performance of Dolly Athol during this test is believed to be almost, if not quite without precedent in the annals of butter tests that have been controlled by chemical analysis. The sudden increase from 19.2 oz. to 33.1 oz. butter fat in twenty-four hours on removal from home to strange and disquieting surroundings was most unexpected but is fully authenticated. Close watch was kept on the milkers and it was believed that no tampering took place, but to render assurance doubly sure the man in in charge of the cow was surprised by the appearance of a Station officer early on the morning succeeding the test. The cow was milked, and every motion of the milker watched, the milk was weighed (12.69 lbs.) mixed and sampled, and the sealed sample taken to the Station laboratory, where it proved to be even richer than the preceeding samples, analyzing 16.66 per cent total solids. and 7.20 per cent fat or 14.69 oz. butter fat. The cow calved Aug. 25th, was fed but lightly for a few days, then moderately with bran and hay. The cow gave on the average while milking, 22.75, 13.20 (farrow), and 23 lbs. milk per day in 1887-'88-'89 respectively. The analyses and weights connected with the test are as follows, the first two being of milk given at the farm, the last three of that given at the fair grounds.

Date of Milking.	Weight. lbs.	Total Solids. %	Fat. %	Casein. %	Sugar and Ash. %
Sept. 1, P. M.	14	14.25	4.41	4.38	5.46
" 2, A. M	12.50	14.90	4.65	4.29	5.96
" 4, A. M	17.25	16.02	6.82	3.57	5.63
" 4, P. M.	13.75	15.45	6.50	3.53	5.42
" 5, A. M.	12.69	16.66	7.20	3.69	5.77

It is safe to assert that so rich a milk as shown by the last three analyses, has seldom been given by an Ayrshire cow in flush of milk.

It was intended to keep track of this cow on her return home, by frequent analyses of her milk, but her sudden death prevented. On her return a week later from the State Fair at White River Junction, where she

had been exhibited, she, in common with the rest of Mr. Drew's herd were unshipped at the railroad depot at night. The herd became frightened and stampeded, she, with three others, going off the dock into the lake, where she was drowned.

To summarize: the results obtained of the effect of worry and confusion on the system of cows, as shown in the milk flow, appear conflicting, depending upon individuality. Some cows produced more at home amid their usual surroundings, while some seemed stimulated by excitement and nervousness, and made a better showing at the fair grounds than they did at home. The data at hand seems to indicate that *the tendency of nervous excitement, is to lessen quantity of milk ingredients, and to variously affect quality according to the individuality of the animal, the fat being the most variable ingredient.*

WOOL AND WOOL MEASUREMENTS.

BY W. W. COOKE AND L. R. JONES.*

A considerable time and painstaking was given to the study of wool-fibers during the winter of 1889-90, and especially to the microscopic examination and measurement of the diameters of different samples.

The object of this was two-fold: first, to learn the character of Vermont merino wool as compared with wool from other breeds and localities; second, and more especially, to get data to serve as a basis for future experimental work upon conditions affecting the wool-fiber.

Such being our object it is thought best to here publish, not only the facts of general interest, but also the details of some of the work in testing various microscopic methods.

In making all measurements of diameters it is necessary to magnify the wool-fiber very highly. For this a microscope magnifying about 600 diameters was used.

Fig. 1 shows three wool fibers from the shoulder of Ram 127, as they appeared under the microscope after they were cleansed. They are magnified 300 diameters, in the figure, which is one-half of the diameter as magnified by the microscope used. The micrometer scale used in the measurements lies across the center of the fibers. Each division on this scale represents .2792 centimillimeters, or about $\frac{1}{9100}$ of an inch. Thus the fiber at the left measures about 9 spaces in diameter, this equals $9 \times .2792 =$ 2.5128 centimillimeters or $\frac{9}{9100} = .000989$ of an inch. A glance at the tables on page 60 will show that the average of the fibers from the shoulder of Ram 127 is 2.365 centimillimeters; by applying the above method of calculation it will be found that this diameter is represented by about $8\frac{1}{2}$ spaces of the scale. Thus the middle fiber at the point where the scale crosses it is about the average size.

* The microscopical examinations were made by L. R. Jones.

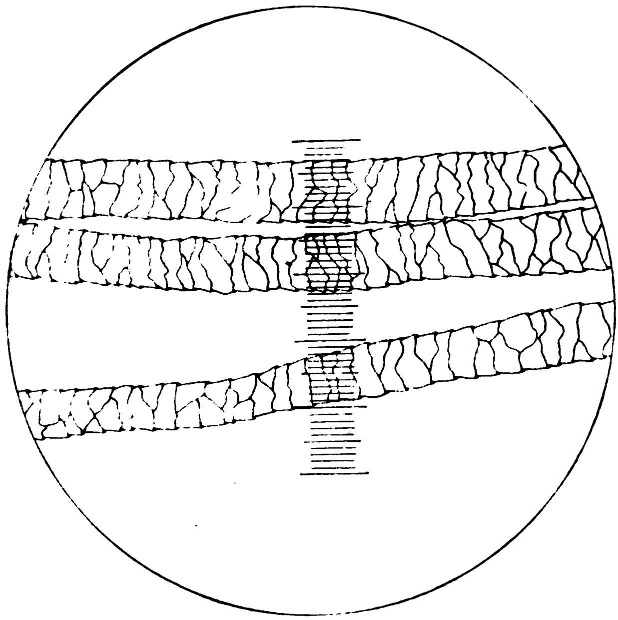


Fig. 1.

Three wool fibers from the shoulder of Ram 127 magnified about 300 diameters Drawn with camera).

Before exact measurements upon the fibers could be made it was found necessary to cleanse the wool in some solution that would remove the "yolk" and dirt, This is done at the woolen mills by washing with some alkaline solution.

Samples of several of the standard soaps and "solvents" were gotten from the Burlington Woolen Mills and tested along with benzine, carbon-bisulphide, and ether. All of these were found to remove the yolk and dirt. It was found, however, that after the fibers cleansed with these solvents were allowed to dry thoroughly they shrank perceptably in diameter. A couple of examples will illustrate this. The average of 100 measurements on a sample of wool *freshly cleansed with "clover solvent' soap † and dried in a current of warm air, was 2.633 centimillimeters ($\frac{1}{1000}$ of an inch). The average of 100 measurements made on the same sample three months later, was 2.43 centimillimeters showing a shrinkage of about

* A sample of the wool was cleansed, then ten fibers selected and mounted and ten measurements made on each fiber.

† The method of cleansing was that recommended by the chemist in charge of the cleansing of the wool at the woolen mill, viz.; Placing the wool in a 5 per cent. solution of clover solvent at temperature 130°—135° F. for one-half hour, then transferring to a bath of clear water at about 120° F. and finishing by rinsing in cold water.

7½ %. Another series of 100 measurements on ten fibers cleansed in benzine gave an average diameter of 2.804 centimillimeters, and a second series of 100 measurements on the same fiber after drying three months gave an average of 2.6, showing a similar shrinkage of about 7%.

Careful measurements were also undertaken to determine whether in the process of cleansing with benzine and drying for only a few moments in a current of warm air the fibre was perceptibly swollen or shrunken. One hundred measurements on an uncleansed sample showed an average diameter of 2.804 centimillimeters; 100 measurements on fibers taken from as near the same spot as possible and cleansed, averaged 2.815 c. m. m., showing a shrinkage of about ½ of one per cent. All of these preliminary measurements were made upon the sample taken from the hip of one sheep (Ewe 44). The average of all measurements upon uncleansed fibers from this hip sample was 2.74 c. m. m., while the average of all measurements from the same sample and comparable to the last, except that they had been cleansed with benzine, was 2.78 c. m. m. These last apparently show a slight swelling of the fiber amounting on the average to about 1½%.

The possible change in the size of the fiber from the use of benzine as a solvent was thus shown to be very slight when measurements are made before long continued drying of the cleansed fibers. It was therefore considered a satisfactory solvent to use. But it was not convenient or possible even to measure all fibers promptly after cleansing. Hence the next step was to find some mixture in which the fibers could be preserved and which would keep them from drying. Benzole balsam * was tried and found very satisfactory. The method of cleansing and mounting the fibers used in making all the measurements here recorded was as follows: The sample of wool was immersed for five minutes in benzine, being shaken occasionally to wash out particles of dirt, then dried for about one minute in a current of warm air over a register or a coal stove and at once mounted in benzole balsam. After this it underwent no apparent change and was measured at convenience. In the earlier part of the work ten fibers were selected at random from the sample and the diameter of each of these fibers measured in ten different places. This method was found unsatisfactory in several ways however. The painstaking necessary in selecting and mounting the fibers was a serious objection. The value of results in this work depends especially upon making a very large number of measurements from which averages can be gotten. Some rapid method of prepâring samples for measurement is therefore desirable. Had this method of making all measurements upon ten fibers given the best obtainable results, however, it would have been followed regardless of time.

* Canada balsam dissolved in benzole. This was used by McMurtrie in his extensive series of measurements upon wool fibers, the results of which are given in his "Report Upon an Examination of Wool and Other Animal Fibers," made under direction of the Commissioner of Agriculture, Washington, 1886.

But such was not the case. There is often so great variation in the size of fibers growing side by side that among the ten fibers selected there was often an abnormally large or abnormally small one that raised or lowered the general average of the measurements to a misleading degree.* While in following this method the average of all measurements on one sheep would be substantially correct, the average of any one sample might be quite misleading.

The method which was found more satisfactory and which was followed in making all measurements here recorded was to mount a small sample of wool entire. Such a sample would contain several hundred fibers. Beginning then at the butt-end ten measurements of what appeared typical fibers were made; then moving along a little toward the tip of the sample ten more measurements were made. This process was repeated until one hundred measurements, representing the whole length of the sample, were made and recorded. The average of these diameters was taken as representing the average diameter of the fibers of that sample.

The series of duplicate measurements made on Ram 126 and recorded further on show the reliability of this method.

When the sample was of from six months' to a year's growth it was necessary to cut it in sections for convenience in mounting on the glass slides for the microscope. In such cases the sample was cleansed and dried ready for mounting, then cut into three equal portions, each of which was mounted on a slide by itself. The butt third was labelled B^{I}, the middle B^{II}, the tip end B^{III}. Thus, B^{III} is the oldest growth and B^{I} the most recent. When the sample was thus divided, thirty measurements were made on each third, or ninety on the whole sample.

The following measurements were made upon samples from the fleeces of four registered Merino sheep from the flock of Albert Chapman of Middlebury, Secretary of Vermont Merino Sheep-Breeder's Association.

Fig. 2, shows the places on the sheep from which the samples were taken. These places are numbered in the order of the fineness of the wool taken from them as shown in the table of averages on page 62.

* There was scarcely a sample examined where the larger fibers were not at least one-half larger than the smaller ones of the same sample, and cases were very common where the larger were twice and even three and four times the diameter of the smaller.

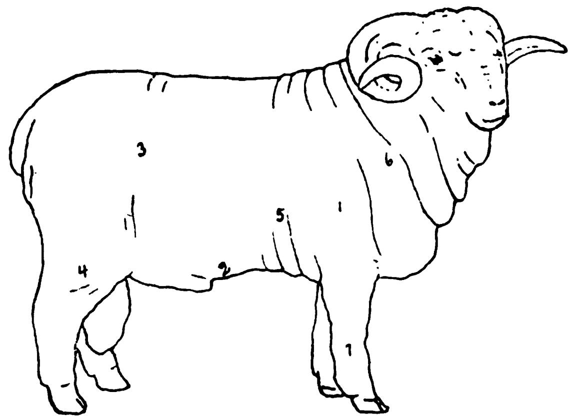


Fig. 2.

The figures show the points from which the samples were taken for measurement and also the relative fineness of these samples. 1 Shoulder, 2 Belly, 3 Hip, 4 Thigh, 5 Body Wrinkle, 6 Neck Wrinkle, 7 Leg Below Knee, (The last does not rank 7th in size, but as only one set of samples was measured [Ram 127] no rank is given it.)

The following tables give the averages of the measurements:

Ram 126. Average of Two Series.	B1		B11		B111		Averages.	
	Centimillimeters.	1/1000 Inches.	Centimillimeters.	1/1000 Inches.	Centimillimeters.	1/1000 Inches.	Centimillimeters.	1/1000 Inches.
Shoulder	2.194	.8635	2.291	.9019	2.129	.8380	2.204	.8678
Body Wrinkle	2.361	.9294	2.361	.9394	2.321	.9138	2.356	.9275
Hip	2.228	.8770	2.191	.8626	2.186	.8608	2.202	.8668
Thigh	2.354	.9267	2.465	.9706	2.363	.9303	2.394	.9425
Belly	2.164	.8517	2.082	.8196	2.237	.8808	2.163	.8517
Neck Wrinkle	2.389	.9404	2.438	.9600	2.417	.9514	2.415	.9506

Ram 127.	B[1]		B[11]		B[111]		Averages.	
	Centimillimeters.	$\frac{1}{1000}$ Inches.	Centimillimeters.	$\frac{1}{1000}$ Inches.	Centimillimeters.	$\frac{1}{1000}$ Inches.	Centimillimeters.	$\frac{1}{1000}$ Inches.
Shoulder	2.540	1.0000	2.321	.9138	2.233	.8791	2.365	.9310
Body Wrinkle	2.560	1.0770	2.879	1.1336	2.521	.9926	2.712	1.0677
Hip	2.345	.9231	2.475	.9743	2.498	.9835	2.439	.9602
Thigh	2.675	1.0549	2.763	1.0879	2.494	.9817	2.645	1.0414
Belly	2.442	.9615	2.345	.9231	2.279	.8974	2.355	.9272
Neck Wrinkle	3.242	1.2764	3.252	1.2803	3.405	1.3406	3.302	1.3000
Leg below knee	2.409	.9483	2.237	.8809	2.396	.9432	2.348	.9243

Ewe 44.	B[1]		B[11]		B[111]		Averages.	
	Centimillimeters.	$\frac{1}{1000}$ Inches.	Centimillimeters.	$\frac{1}{1000}$ Inches.	Centimillimeters.	$\frac{1}{1000}$ Inches.	Centimillimeters.	$\frac{1}{1000}$ Inches.
Shoulder	2.229	.8773	2.410	.9487	2.047	.8058	2.228	.8772
Body Wrinkle	2.605	1.0256	2.810	1.1062	2.531	.9963	2.648	1.0426
Hip	2.364	.9308	2.363	.9304	2.385	.9390	2.371	.9334
Thigh	3.059	1.2042	3.024	1.1904	2.591	1.0201	2.891	1.1382
Belly	2.466	.9707	2.754	1.0842	2.466	.9707	2.562	1.0085
Neck Wrinkle	3.443	1.3553	3.354	1.3205	2.656	1.0458	3.018	1.1881

Ewe 64.	B^{I}		B^{II}		B^{III}		Averages.	
	Centimillimeters.	$\frac{1}{1000}$ Inches.	Centimillimeters.	$\frac{1}{1000}$ Inches.	Centimillimeters.	$\frac{1}{1000}$ Inches.	Centimillimeters.	$\frac{1}{1000}$ Inches.
Shoulder	2.303	.9066	2.140	.8424	2.196	.8644	2.213	.8712+
Body Wrinkle	2.447	.9633	2.489	.9800	2.359	.9286	2.432	.9572+
Hip	2.447	.9633	2.326	.9157	2.117	.8333	2.296	.9040+
Thigh	2.335	.9193	2.261	.8901	2.819	.7948	2.205	.8681+
Belly	1.996	.7857	2.047	.8058	1.865	.7342	1.969	.7752+
Neck Wrinkle	2.193	.8633	2.042	.8040	2.066	.8132	2.103	.8277+

In order to determine the accuracy of these results two series of measurements were made upon the samples from Ram 126. Below are the tabulated results of these measurements.

Ram 126. First Series of Measurements.	B^{I}		B^{II}		B^{III}		Averages.	
	Centimillimeters.	$\frac{1}{1000}$ Inches.	Centimillimeters.	$\frac{1}{1000}$ Inches.	Centimillimeters.	$\frac{1}{1000}$ Inches.	Centimillimeters.	$\frac{1}{1000}$ Inches.
Shoulder	2.140	.8427	2.419	.9525	2.094	.8244	2.218	.8732
Body Wrinkle	2.336	.9195	2.266	.8921	2.205	.8683	2.269	.8934
Hip	2.219	.8738	2.177	.8572	2.131	.8389	2.176	.8566
Thigh	2.391	.9415	2.503	.9855	2.457	.9673	2.451	.9648
Belly	2.146	.8448	2.164	.8518	2.210	.8700	2.173	.8556
Neck Wrinkle	2.485	.9782	2.485	.9782	2.410	.9489	2.460	.9685

Ram 126. Second Series of Measurements.	B^{I}		B^{II}		B^{III}		Averages.	
	Centimillimeters.	$\frac{1}{1000}$ Inches.	Centimillimeters.	$\frac{1}{1000}$ Inches.	Centimillimeters.	$\frac{1}{1000}$ Inches.	Centimillimeters.	$\frac{1}{1000}$ Inches.
Shoulder	2.247	.8847	2.154	.8480	2.164	.8519	2.188	.8617
Body Wrinkle	2.387	.9397	2.508	.9873	2.438	.9599	2.444	.9623
Hip	2.243	.8830	2.205	.8683	2.243	.8830	2.230	.8779
Thigh	2.317	.9123	2.429	.9562	2.270	.8938	2.339	.9208
Belly	2.182	.8590	2.000	.7876	2.266	.8921	2.159	.8499
Neck Wrinkle	2.294	.9031	2.391	.9415	2.424	.9544	2.370	.9330

The average of all measurements on shoulder, hip and belly of the first series is 2.189 cmm.. The corresponding average in the second series is 2.192 cmm., showing a variation of only about one-seventh of one per cent. On the neck wrinkle, body wrinkle and thigh, the differences are greater respectively (3.7%, 7% and 4.5%.) These apparent discrepancies are however of the nature of proof of the accuracy and value of the measurements, since the variations in size of the fibres from different parts of a wrinkle, and the uneven quality of the wool on the leg are facts well known to every one who has examined wool with care.

The measurements show the fibres from belly and shoulder to be of nearly equal fineness—the belly being a little the finer of the two. The order of fineness with average diameters is as follows :

	Centimillimeters.	$\frac{1}{1000}$ Inches.
1 Shoulder	2.252	.8866
2 Belly	2.262	.8905
3 Hip	2.327	.9161
4 Thigh	2.534	.9976
5 Body Wrinkle	2.537	.9988
6 Neck Wrinkle *	2.709	1.0665

Comparison of the measurements on the rams with those on the ewes show the rams' fibers to be slightly but not markedly larger than the ewes'.

* As a sample was taken below the knee (point numbered 7 in the figure) from only one sheep, Ram 127, the relative fineness of that point is not included in this table.

	Centimillimeters.	$\frac{1}{1000}$ Inches.
Average of all measurements on both rams	2.454	.9661
Average of all measurements on both ewes	2.411	.9492

These results are in accord with those of other investigators.

A very interesting fact was noticed in Ewe No. 44. All the fibers examined were much smaller for about one-tenth of their length from the tip than they were for the rest of their length. Upon inquiry of the owner it was learned that the ewe dropped her lamb about shearing time, and that she was always sickly for some time after lambing.

The fibers from none of the others showed any such shrinkage at their tips.

EXPERIMENT TO DETERMINE THE EFFECT OF FEED ON WOOL-FIBER.

It was desired to find out whether or not different rations affect the character of the wool of the sheep, and if they do affect it, then in what way.

Eight registered Merino ewes, two-years-old, were placed at the disposal of the Station for the experiment by Mr. Bissell of Shoreham and Mr. L. W. Peet of Cornwall, four taken from the flock of each gentleman.

The experiment was continued three months—from January 6th to March 31st, 1890. During this time two of the sheep (one from Mr. Bissell's flock and one from Mr. Peet's), were kept on a carbonaceous ration, two were similarly kept on a nitrogenous ration, two others were kept the first six weeks on a carbonaceous ration and the last six weeks on a nitrogenous ration, and the other two were kept on a nitrogenous ration the first six weeks and on a carbonaceous ration the last six weeks.

Careful measurements were made upon the wool at the beginning, at the middle and at the end of the period. But as the difference between the measurements upon the same individuals were found to be greater than the differences between averages, no conclusions were thought justifiable.

It is, however, thought best to here give an outline of the methods employed for the information of those who may continue the work in the future.

At the beginning of the experiment small samples of wool were taken from the right hip and left shoulder of each sheep. Careful measurements were made upon the length and the diameter of fiber of these samples in order to get a basis for comparison of succeeding measurements.

For cutting these samples a pair of fine, sharp-pointed scissors, with curved blades (finger-nail scissors) were found most convenient.

It was necessary to distinguish exactly in some way between the growth of wool previous to January 6th and that growth which took place during the period of the experiment. In the case of those sheep which were given a different ration the second half of the period from that given them during the first half it was further necessary to distinguish exactly between the growth of the first and of the second halves of the period.

Two possible methods of doing this suggested themselves.

First—After taking a sample of the wool for measurement to dye the fleece on a small spot. If some dye could be found which would dye the fibers without irritating or stimulating the skin then the exact limit between previous and succeeding growth would be defined and permanently registered in the fiber itself.

The Magenta Diamond Dye was tried. It was found neeessary to cleanse the wool with a little benzine before it would take the dye well. This benzine and possibly the dye also irritated the skin of the animal to such a degree that an exudation was thrown out which matted the wool together and even caused a shedding of the wool on the irritated spot in one case where the benzine was used quite freely.

Such a method could not therefore be followed.

The second method tried was more satisfactory. It was to clip the wool carefully and closely from a small spot.

By clipping a narrow area (an inch and a half long and one-half inch wide), the wool from the sides closed in over the spot at once and apparently kept the spot in normal condition as regards moisture, temperature and protection.

In those cases where it was necessary to distinguish between the growths of the first and second halves of the period a small area was again clipped at the middle of the period in the center of the area clipped January 6th.

The methods followed in measurements of diameters were the same as outlined in the preceding measurements.

Some of the sheep did not do well, owing to the change of surroundings, and it was found that the fibres of these sheep were correspondingly shrunken in diameter. The fact that the diameter of the fibre is shrunken when the sheep is sick, was also noticed in the case of Ewe 44, already mentioned.

It is one of the most suggestive observations made. This fact indicates that further investigation may show that not only the length of staple and the amount of yolk is increased by good care and proper feeding as wool-growers claim, but also that the diameter of the fiber is increased—a thing not so generally believed.

DAIRYING.

There is no other industry so prominent in Vermont as dairying, and for this reason the Experiment Station has always made this the principal part of its work, taking *Dairying* however in the widest sense of the word as including the growing of the fodder for milch cows, the feeding of these cows and the care and handling of the milk. In the succeeding pages will be found an account of some of the experiments that have been completed during the past year, under the following heads:

1. Milk globules.
2. The effect of succulent food on churnability.
3. The effect of heavy grain feeding.
4. Comparison of the feeding value of hay, ensilage and corn fodder.
5. Milking two and three times a day.
6. Mechanical losses in handling milk.
7. Relation of fat and casein in milk.
8. Cream raising by dilution.
9. Effect upon milk of the change from barn to pasture.
10. Miscellaneous notes on handling milk.

STUDY OF MILK GLOBULES.

BY L. R. JONES.

I. METHODS.

A compound microscope, magnifying about 500 diameters was used. Two general methods of preparing the milk for examination were followed.

First.—Mounting on flat slides as in ordinary microscopic preparations.

Second.—Babcock's method of mounting in capillary glass tubes.

Concerning the first method little need be said. A ring of benzole balsam was made on the slide, a small drop of milk placed within this and the cover glass pressed over the whole as closely as possible. Slides thus prepared remained without perceptible change for some hours or even days. When the slide was allowed to lie quietly for a short time the fat globules rose and lay close against the under side of the cover-glass. Lying thus in a common plane they were easily measured, counted and compared. In most of the comparative study of milk from different breeds this method was followed.

Since the thickness of the layer of milk between the cover slip and slide cannot be determined with accuracy the number of globules in a given volume of milk cannot be determined by this method.

Babcock's method* is intended to enable one to make such a quantitative measurement.

A glass tube about 3-16 inch diameter was heated until softened, then quickly drawn out to capillary size so that the bore of the tube thus formed is only 1-200 to 1-500 of an inch. Selecting the most uniform of this capillary tubing it was broken into pieces about an inch long. Upon dipping the end of one of these pieces into milk,the milk was at once drawn into the tube by capillary action and filled it. The ends of the tubes thus filled were sealed with vaseline, and fastened to a microscope slide. After the tube lay a short time in one position the fat globules all rose to the top and owing to the curvature of the tube were thus brought in a row close against the upper side of the tube. They could be studied then as in the other method of preparing. The important advantage of this second method over the first is that by measuring the diameter of the tube, the exact quantity of milk under examination can be calculated. If ordinary undiluted milk is placed in a tube in this way the globules are so numerous that they cluster thickly together against the upper side of the tube and it is impossible to make accurate measurements or counts. It is necessary therefore to dilute the milk with fifty times its bulk of water.

II. RESULTS.

I. Size of Fat Globules in Milk. — In diameter the globules varied from $\frac{1}{1800}$ of an inch, the largest perfect globules which were found in any great numbers, to $\frac{1}{4000}$ of an inch, the smallest. Occasionally globules were seen larger than $\frac{1}{1000}$ of an inch, and doubtless many are smaller than $\frac{1}{4000}$ of an inch.

The proportional number of the globules of the different sizes is shown in the following table, which is an average of examinations made on three thoroughbred Jerseys that had been in milk nearly four months.

4%	of the	globules	were	between	.000385 and	.000275	inches in	diameter.
22%	"	"	"	"	.000275 "	.000165	"	"
26%	"	"	"	"	.000165 "	.00011	"	"
28%	"	"	"	"	.00011 "	.000055	"	"
20%	"	"	"	smaller than	.000055		"	"

The number of globules larger than .000385 was so small in comparison with the others that no percentage estimates were attempted.

In examining the above table one should constantly keep in mind the fact that one of the larger globules contains as much butter-fat as a large

* See. IV. Rep. N. Y. Exp. Sta., 1885; also VI and VII, Reports Wis. Exp. Sta., 1889 and 1890.

number of the smaller ones, since the volume of spheres varies not as the diameter, but as the *cubes of the diameters.* To show this more clearly, let the diameter of one of the smallest globules .000055 be represented by 1. According to the same ratio the diameter of the next largest set would be represented by 2, of the next larger set .0000165 by 3, of the next by 5, and of the next and largest by 7. Then the ratio between the actual sizes of the globules is found by cubing those diameters, which gives us respectively 1, 8, 27, 125, 343. Hence one globule .000385 inches in diameter contains as much butter-fat as 343 globules .000055 in diameter.

Carrying out these calculations for the averages of Jersey milk given above it shows that 27% of the total fat is contained in the largest globules, 55% in the next smaller grade, 12% in the next grade, 5.5% in the next, while the smallest size, which makes up about one fifth of the total *number* of globules, contains but *one two-hundredth* of the total fat.

The results of such an examination as this are rather suggestive than decisive. Following are some of the conclusions that seem justifiable.

I. Influence of Breed.—The Jersey and Holstein were the ones most carefully studied and compared. There was a very marked difference in the appearance of the two, the Jersey having relatively more of the largest sized globules, the Holstein less of these and more of the smaller. In the samples examined it was as easy to distinguish the Holstein from the Jersey milk under the microscope as it is to distinguish the Holstein from the Jersey cow in the herd.

Even those samples of Holstein milk from cows selected as the best butter cows, showed the same characteristic absence of larger globules. The period in lactation of these cows was not known, but the examination of Hepsy's and Dinah's milk showed that even when new in milk the larger globules are noticeably few.

The Ayrshire milk was intermediate between Holstein and Jersey as shown by the sample from Myrtle.

The Guernsey seemed comparable to the Jersey, although Betsey being so new in milk makes the result less significant.

The Devons, judging from Nellie Bly, have very small globules.

II. Influence of Lactation.—The period of lactation has a marked influence on the size of the globules. The sample from Betsey, who calved only a week previous to the examination, showed nearly 50 per cent of the larger size of globules. Juno and Hilda on the other hand may be compared to Myrtle as showing how the globules are much smaller, and consequently more numerous, in the later stages.

III. The Relation between Size of Globules and Richness of Milk.—The size of globules had no direct relation to richness of milk. Filia, the Jersey giving richest milk, showed fewer of the largest sized globules than the other Jerseys. Hilda, who was giving the richest milk of the Ayr-

Comparison of Milk from Cows of Different Breeds and in Different Periods of Lactation.

Name of Cow.	Breed.	Calved Last.	Calved Next.	Date of Examination.	Station No. of Sample.	Per Cent of Fat.	Per Cent of Globules Diameter .000385 to .000275 Inches.	Per Cent of Diameter .000275 to .000165 Inches.	Per Cent of Diameter .000165 to .00011 Inches.	Per Cent of Diameter .00011 to .000055 Inches.	Per Cent of Diameter Less Than .000055 Inches.
Filia	Jersey	Aug. 22, '89	......	Dec. 19, '89	6211	6.70	1.5	25.4	27.	28.6	17.4
No. 17	"	Sept. 1, '89	......	"	6222	5.13	5.08	20.3	20.3	23.7	30.5
No. 5	"	" "	......	"	6221	4.30	5.08	20.3	30.5	32.2	11.7
Daisy	Grade Jersey	June, 1, '89	......	"	6220	4.92	5.4	6.5	31.5	34.8	21.75
Lottie	" "	Sept. 3, '89	......	"	6217	4.64	0.	22.9	22.9	27.1	27.1
Dorothy	" "	April 6, '89	May 15, '90	"	6216	6.11	2.08	20.8	20.8	34.	23.
Nellie Bly.	Devon	Aug. 15, '89	......	"	6218	4.34	0.	3.75	16.25	37.5	42.5
* ———	Holstein	....	......	Jan. 25, '90	6300	4.79	1.48	5.88	19.11	29.41	44.11
* ———	"	....	......	"	6299	5.61	1.47	17.67	22.1	36.66	22.1
* ———	"	....	......	"	6301	4.89	2.	16.7	16.7	33.4	31.2
Hepsy	Grade Holstein and Jersey	Nov. 1, '89	......	Dec. 19, '90	6210	4.15	2.6	13.2	30.3	35.5	18.4
Dinah	Grade Holstein and Durham	Dec. 1, '89	......	"	6209	3.78	2.8	16.8	19.6	28.	32.7
Myrtle	Ayrshire	Oct. 1, '89	......	"	6219	3.96	3.	13.	31.	13.	40.
Juno	Grade Ayshire and Durham	April 8, '90	May 1, '90	Dec. 20, '90	6215	4.59	0.	2.5	11.7	28.4	57.4
Hilda	Grade Ayrshire and Durham	Nearly 2 yrs. before.	May 20, '90	"	6214	5.16	0.	2.5	16.7	25.	55.7
Betsy	Grade Guernsey	Dec. 12, '89	......	Dec. 19, '90	6212	4.55	14.06	34.4	18.7	21.9	10.94

* These three samples were from cows selected from the herd of a leading breeder of Holsteins, being his best butter cows.

shires, again showed the smallest globules. Betsy's milk showing so many large globules was of medium richness.

IV Compa rative Size of Globules in Whole and Skim Milk.—Examination of skim milk showed that the larger globules were all removed. This is what might be expected since the large globules would rise to the top quickest in the process of creaming. This is a very significant fact, since, as has been pointed out by others, it give us a hint of the explanation of some important practical questions. Among these are the reason for better work done by the separator than by the older process of creaming, the centrifugal action of the separator being sufficient to throw out smaller globules than will separate in the natural process of creaming. As mentioned in work on creaming in another part of this report, Betsy's milk which has the most large and fewest small globules, creams better than that of any other cow in the station herd. The relative abundance of small globules and scarcity of larger in cows well along also in lactation and in farrow cows is in the same way a partal explanation at least of the slower creaming of milk from such cows.

III. *With what Accuracy can the amount of Butter Fat in milk be determined from Microscopic measurements.*

Babcock's method of preparing milk in capillary tubes, for quantitative microscopic measurements has been described. Using this method, a considerable study was given to the above question. Careful measurements were made on a number of samples, the percentage of fat in the sample calculated from these measurements and compared with the results of chemical analysis.

The most satisfactory results, however, showed wide variations.

There were several reasons for this.

First.—Difficulty was experienced in getting satisfactory duplicates.

Second.—The measurements were made of the diameter of the globules. The contents of the globules vary as the cubes of these diameters. Hence even slight errors in measurements of these diameters became quite serious when the contents were calculated.

Third.—When any small opaque object is held between the eye and a bright light it appears smaller than it really is. This is readily seen if a pencil is held between the eye and a bright lamp. The sides of the pencil where the light strikes brighest will appear curved in toward the center. The same phenomenon is better shown if you stand in such a position that a telegraph pole or similiar object is between your eyes and the moon on a bright moonlight night.

The milk globules when examined under the microscope are placed similarly to the pencil or post between a bright light and the eye of the observer. Hence the globules appear smaller than they really are. While this error is of little importance in ordinary examination it may become a source of considerable error if quantitative determination is undertaken.

THE EFFECT OF SUCCULENT FOOD ON THE CHURNABILITY OF THE FAT IN MILK.

BY. W. W. COOKE.

During the last two years this Station has made tests of handling milk by various methods and from many different feeds. From the large mass of records thus accumulated it is possible to select quite a number that have a bearing on the question of churnability. But before presenting the figures, it may be well to consider what is meant by the term "churnability." It is used at present to denote the thoroughness of the work of skimming and churning, the per cent of "churnability" being the number of pounds of butter fat saved in the butter, for each 100 pounds, of fat in the whole milk from which this butter is made. This per cent of churnability is quite variable, sometimes 95 pounds are saved out of the 100, and in other cases less than 70 pounds are saved. This difference is known to be influenced by several causes. The farther advanced a cow is in the period of lactation, the harder it is to get the fat out of the milk; the larger the globules of fat in the milk the more completely the fat separates from the skim-milk and the butter-milk. These last two statements apply to the milk of cows all handled under the same system. But the system itself has something to do with the amount of fat recovered in the butter. Under ordinary conditions the separator will recover a larger proportion of the fat than any other system in general use.

In addition to these well known and thoroughly established factors that affect churnability, the theory has recently been advanced that succulent food, by reason of its succulence, would increase the churnability of milk, or stated in other words, more butter would be made from milk of the same degree of richness when the cows were eating succulent food, than when their food was dry. There are four factors that govern the amount of butter that will be produced from a given sample of milk. 1. The amount of fat lost in the skim-milk, 2. The amount of fat lost in the butter milk. 3. The amount of fat lost in the process of manufacture—such as cream sticking to the sides of pails and pans, and butter in the churn and worker, and 4. The amount of water, salt and curd that the butter contains. The last two of these bear no relation to the cow, her feed, or the method used for skimming and churning, and by all rights should be entirely eliminated from the problem. No one claims that butter is constant in its composition, and it is easy to find analyses that range from 62 to 87 pounds of butter fat in a hundred pounds of butter. Hence the mere weight of the butter is no guide to the amount of butter fat it contains. The third factor, the mechanical losses, is more important than it has usually been considered. Theoretically the sum of the fat in the butter, the butter-milk and the skim-milk should just equal the fat in the original whole milk. In prac-

tice they always fall short owing to the unavoidable losses in handling. On a large scale these losses can be disregarded. In our tests of creameries we have had cases where the fat in the butter, butter-milk and skim-milk came within two pounds of the fat in the whole milk on a churning of four hundred pounds of butter. Such a slight loss, equal to one-half of one per cent, could be disregarded; but when the same discrepency occurs on a churning of twenty pounds, it becomes a loss of ten per cent and is serious. Yet such proportionate losses as these are not at all uncommon in small churnings. The general rule is that the smaller the amount of milk, cream and butter handled, the larger will be the proportional losses. In the testing of single cows, it is very difficult to keep these mechanical losses below six per cent.

It will readily be seen, therefore, that to get at the real facts of the churnability of milk, we must eliminate from our results all possibility of error from mechanical losses and from variations in the quality of the butter, that is we must confine ourselves to the losses in the skim-milk and butter-milk. Broadly stated then the definition of the per cent of churnability would be the per cent of the fat in the whole milk left after deducting the fat lost in the skim-milk and the butter-milk.

An example will show what is meant.

2500 pounds of milk with 4.50 per cent of fat, contains 112.50 pounds of fat. If this is handled so as to give 1900 pounds of skim-milk containing 0.50 per cent fat and 500 pounds of butter-milk containing 0.75 per cent fat, there will be lost in the—

Skim-milk	1900 x 0.50	9.50 lbs.
And in the butter-milk	500 x 0.75	3.75 "
	Or a total loss of	13.24 lbs.
Which substracted from 112.50, leaves		99.25 lbs.

99.25 divided by 112.50, gives 88.22 per cent, which would be the per cent of churnability of this sample.

Having now defined what is meant by churnability, we are prepared to examine the tests that have been made at this Station to determine whether succulent food does increase the churnability of the fat in the milk.

In the following tests, the milk was set in deep cold setting submerged, except in the cases noted, where it was run through the separator. In each case except where noted in the first two tests, the temperature of the creamer was essentially the same in both tests, the milk was all skimmed at 24 hours, and the cream from both the deep setting and separator stood 24 hours before churning. It was all churned in a barrel churn by steam power, and for the two parts of each test the temperature of churning was the same.

In the following table, that the comparison may be more easily made, it has been assumed that the milk in each case contained 5.00 per cent of fat, and that for each 100 pounds of milk there were 75 pounds of skim-milk and 20 pounds of butter-milk.

	Per cent of Fat in Skim-Milk.	Per cent. of Fat in Butter Milk.	Per cent. of Churnability.	Per Cent of Churnability in Favor of Wet Feed.	Per cent. of Churnability in Favor of Dry Feed.
One Cow, fed corn ensilage and grain, average of eight days	0.45	0.69	90.49	2·54	
Same Cow, fed dry corn fodder and the same grain, three weeks later, average of eight days, temperature of creamer 8°, in favor of dry fodder	0.15	2.45	87.95		
One Cow, fed dry corn fodder and grain, average of eight days	0.86	1.43	81.38		
Same Cow, fed corn ensilage and the same grain, three weeks later, average of eight days, temperature of creamer 12°, in favor of ensilage	0.75	1.33	83.43	2.05	
Five Cows, fed green barley and grain, average for six days	0.83	0.50	85.55		
Same Cows, fed nine days later on hay and the same grain. Average of six days	0.67	0.72	87.07		1.52
Four Cows, fed green barley, bran and buckwheat middlings. Average of six days	1.24	0.48	79.48		
Same Cows, fed nine days later on hay, corn-meal, cotton-seed and gluten-meal. Average for six days	0.79	0.75	85.15		5.67
Three Cows, same test as last	0.82	0.66	85.06		
Three Cows, same test as last	0.51	1.01	88.31		3.25

	Per cent of Fat in Skim-Milk.	Per cent of Fat in Butter Milk.	Per cent of Churnability.	Per cent of Churnability in Favor of Wet Feed.	Per cent of Churnability in Favor of Dry Feed.
Twelve Cows, hay and grain. Milk put through separator. Average for six days	0.21	0.33	95.53		2.30
Same Cows fed fifteen days later, one-half on dry corn fodder and the other half on corn ensilage, same grain. Average of six days	0.35	0.38	93.23		
One Cow, barn fed on hay and grain. Average of eight days	0.46	0.33	91.78		
Same Cow, on pasture, with same grain four weeks later. Average of eight days	0.38	0.45	92.50	0.72	
One Cow, same test as last	0.69	0.57	87.37		
" " "	0.88	0.43	85.05		2.24
Six Cows, same test as last, but milk run through separator. Average of three days	0.18	0.58	94.98		2.42
Six Cows, same test as last, but milk run through separator. Average of three days	0.32	0.66	92.56		

Recapitulation.—Average per cent of fat in skim-milk from wet feed 0.67

From dry feed 0.50

Difference in favor of dry feed 0.17

Average per cent of fat in butter-milk from wet feed 0.62

From dry feed 0.91

Difference in favor of wet feed 0.29

Average churnability of fat from wet feed 87.49

From dry feed 88.84

Nine tests in all.

Three in favor of wet feed by an average of 1.77

Six in favor of dry feed by an average of 2.91

It is evident from these figures that if there is any difference in churnability on account of feed it is in favor of dry feed.

Are there any changes that take place in the character of the milk when changes are made from dry to wet feed that would tend to influence

the churnability of the fat? Our Station has made many tests of this, and the summary of results is as follows:

Changing from wet feed to dry.

	Wet feed, per cent.	Dry feed, per cent.
Total solids, 5 cases	13.98	14.00
Fat, 12 cases	4.97	4.99
Changing from dry feed to wet.		
Total solids, 19 cases	13.63	13.53
Fat, 25 cases	4.50	4.45

Our own figures show that where foods of equal palatability and nutritive value are given, when cows are in the barn and under uniform conditions, there is practically no change in the character of the milk.

Some recent and yet unpublished work of this Station seems to show that there is a slight difference in the size of the milk globules when on wet feed from their size when the food is dry. The globules are a trifle smaller, which would have a tendency to make the creaming a little poorer from the wet feed than the dry, as indeed the figures already given seem to show. The total solids being a little larger under wet feeding than dry, would also tend to produce poorer work in skimming.

To recapitulate. *1. Whatever difference there is in the character of the milk from wet feed and dry, would naturally tend to produce better results from the dry feed. 2. In a long series of tests, two-thirds of them showed the greatest churnability with the dry feed. 3. These differences are so slight that they can be disregarded and our results can be claimed to show that churnability is not influenced by the succulence or dryness of the feed.*

These conclusions are at variance with those arrived at by another experiment station of this country, but on reviewing their work they have been led to believe that their first conclusions were unwarranted, and that the statement given above is correct. The Maine Experiment Station in their last annual report, give some figures from their work which point in the same direction.

It may, then, be broadly stated that *there is no increase of churnability in the milk fat from wet feed over that obtained from the same cows on dry feed.*

In this connection, it may be remarked that the term churnability is misleading. It is used to conceal the poorness of the apparatus used or the lack of knowledge in the man who is using it. It is possible to take the milk of farrow cows, cows fresh in milk, cows on dry feed, and cows on ensilage, mix the whole together, and with a separator, obtain a skim-milk containing less than 0.20 per cent of fat; then run the cream into the churn while still sweet and obtain a butter-milk with not over 0.30 per cent of fat. What then becomes of "churnability"!!

EFFECT OF THE HEAVY FEEDING OF GRAINS, ON THE QUANTITY AND QUALITY OF MILK.

BY J. L. HILLS.

In the early part of the current year (1890) a test was made at the Station Farm of the effect of an increasingly heavy grain ration on the quantity, quality, creaming and churning of milk and milk products.

Three cows, two (Betsy and Dinah), quite new in milk, one (Daisy), farrow, were chosen for the test, which continued a little over two months, terminating in the case of Daisy with death from over-feeding. Betsy was off feed twice and suffered somewhat from the high feeding.

A mixture of grain was made consisting of 2 tons bran, 1 ton middlings, 1 ton corn meal, 1 ton ground oats, ½ ton cotton-seed, ½ ton gluten meal, ½ ton linseed meal. This is a grain feed that is used at the Experiment Station as the standard grain ration, and is the one meant whenever the term "mixed meal" is used.

Betsy and Dinah were fed as nearly alike as possible throughout the test, the grain ration consisting at first of a gradually increasing amount of this mixed meal until the cows were receiving all they could stand; afterwards they were fed a small amount of the "mixed meal," with the addition of a large amount of some other single meal as corn, bran or rye. There was not much change in the coarse fodder, which consisted throughout of 10–15 lbs. hay and 30–45 lbs. corn ensilage per day, to which was added up to March 11, a daily feed of 10 lbs. apple pomace; thus the variable food was the single grain, the corn, bran or rye on which the experiment was made.

The cow Daisy was fed much the same, except that the grain most used for the variable part was cotton-seed meal, the other feeds tried being bran, gluten meal and rye.

No analyses of the feeds used were made, but a general idea of the nature and amounts of nutrients fed was obtained from our previous analyses of similar products and the average grain analyses tabulated in the first report of this Station.

In spite of the heavy grain feeding neither Betsy or Dinah received at any time a ration as narrow as the standard German 1:5.4. but varying from 1:5.6. to 1:7.9. Daisy's ration was much richer, varying probably from 1:3 to 1:6. The amount of nutrients eaten daily, varied within the following limits: Betsy 2.9-4.4 lbs. protein, 20-24 lbs. carbohydrates: Dinah 2.9-4.4 lbs. protein, 20-27 lbs. carbohydrates; Daisy 2.9-5.4 lbs. protein, 20-24 carbohydrates.

Constant analyses of the whole milk of the cows for solids, fat and casein, were made throughout the test, a mixed sample from every six consecutive milkings being analyzed. The milk of each cow for three days on each increase or continuation of grain feeding was set in cold deep setting, skimmed and churned separately, and samples of all skim and butter milks and butters analyzed. A full record of weights of whole milk given, whole milk set, skim milks, buttermilks, creams and butters was made, cream spaces read, and creaming and churning temperature carefully controlled. If we assume that change in product otherwise unaccounted for is due to change in food, the records stand as follows:

DAISY.

Date.	Daily Grain Ration.	Milk Yield, 3 Days. lbs.	Percentage of Solids.	Percentage of Fat.	Percentage of Casein.	Percentage of Sugar and Ash.	Yield in Ounces for Three Days. Solids.	Yield in Ounces for Three Days. Fat.	Yield in Ounces for Three Days. Casein.	Yield in Ounces for Three Days. Sugar and Ash.
Jan. 26–29*	6 lbs. mixed grain	53.63		4.61				39.55		
Jan.31, Feb.3	1st and 2d days, 6; 3d day, 8 lbs., ½ bran ½ cotton seed meal	51.88								
Feb 3– 6*	8 lbs., ½ bran, ½ cotton seed meal	55.31	13.31	4.32	3.44	5.55	117.93	38.28	30.48	49.17
6– 9	1st day, 8; 2d and 3d days 10 lbs, ½ bran, ½ ½ casene	55.64								
9–12*	10 lbs., ½ bran, ½ cotton seed meal	59.44	13.85	4.72	3.48	5.65	131.99	44.98	33.16	53.84
12–15	12 " " " " "	58.13								
15–18*	12 " " " " "	60.94	13.42	4.35	3.48	5.59	130.85	42.41	33.93	54.50
18–21	12 " " " " "	55.75	13.26	4.36	3.32	5.58	118.28	38.89	29.61	49.78
21–24	†	58.50	13.42	4.57	3.28	5.57	125.61	42.78	30.70	52.13
24–27	1st and 2d day 12 lbs., ½ bran, ½ gluten, 3d day, 10 lbs., ½ bran, ½ gluten meal	59.13	13.08	4.44	3.09	5.55	123.74	42.00	29.23	51.51
Feb.27,Mch.2*	10 lbs., ½ bran, ½ gluten meal	63.13	12.90	4.26	3.28	5.36	130.29	43.03	33 13	54.13
2– 5	10 " " "	60.00	13.30	4.48	3.18	5.64	127.68	43.01	30.53	50.14
5– 8*	10 " " "	58.88	13.35	4.52	3.39	5.44	125.76	42.58	31.93	52.25
5–11	10 " bran	55.06	13.31	4.55	3.28	5.48	117.26	40.09	28.90	48.27
11–14*	10 " "	50.50	13.40	4.66	3.46	5.28	108.27	37.65	27.96	42.66
14–17	10 " ¼ bran, ¾ rye	51.75	13.61	4.92	3.40	5.29	112.69	40.74	28.15	43.80
17–20*	10 " " "	55.06	13.23	4.52	3.46	5.25	116.56	39.82	30.48	46.26

* The milk of these three days set separately skimmed and churned. † Feb. 21, P. M.—22, A. M., fed 12 lbs, ½ bran, ½ cooked cotton-seed meal, refused by cow. Feb. 22, P. M.—23 A. M., 8 lbs., ½ bran, ½ gluten meal was fed, and Feb 23, P. M.—24, A. M , 12 lbs. of the same.

DINAH.

Date.	Daily Grain Ration.	Milk Yield, 3 Days. lbs.	Percentage of Solids.	Percentage of Fat.	Percentage of Casein.	Percentage of Sugar and Ash.	Yield in Ounces for Three Days. Solids.	Yield in Ounces for Three Days. Fat.	Yield in Ounces for Three Days. Casein.	Yield in Ounces for Three Days. Sugar and Ash.
Jan. 22–25*	6 lbs. mixed meal	84.88	12.12	3.51	2.70	5 91	164.59	47.67	36.67	80.25
25–28	8 " " "	93.06	12.00	3.57	2.58	5.85	178.68	53.16	38.42	87.10
28–30	8 " " "	97.44	12.08	3.72	2.63	5.73	188.33	57.99	41.00	89.34
Jan 31, Feb. 3*	10 " " "	102.50	11.93	3.60	2.56	5.77	195.65	59.04	41.98	94.63
Feb. 3– 6	10 " " "	106.13	11.83	3.31	2.89	5.63	200.87	56.20	49.07	95.60
6– 9*	12 " " "	105.06	12.01	3.48	2.89	5.64	201·89	58.50	48.58	94.80
9–12	14 " " "	107.50	12.17	3.54	2.90	5.73	209.32	60.89	49.88	98.55
12–15*	14 " " "	106.88	12.51	3.57	2.93	6.01	213.92	61.05	50.10	102.77
15–18	14 " " "	108.25	12.36	3.54	2.89	5.93	214.08	61.31	50.05	102.72
18–21	14 " " "	109.13	12.21	3.65	2.78	5.78	213.19	63.73	48.54	100.92
21–24	1st day, 14 lbs. mixed meal, 2d and 3d days, 14 lbs., ¾ mixed meal, ¼ corn meal	111.44	12.40	3.67	2.93	5.80	221.09	65.44	52.24	103.41
24–27	12 lbs. ½ mixed meal, ½ corn meal	108.88	12.28	3.56	2.80	5.92	213.92	62.01	48.78	103.13
Feb. 27, Mch 2	12 " ¼ mixed meal, ¾ corn meal	105.19	11.86	3.39	2.76	5.71	199.60	57.05	46.45	96.10
March 2– 5*	12 " " " " " "	100.56	11.94	3.31	2.78	5.85	192.11	53.26	44.73	94.12
5– 8	12 " " " " " "	94.63	12.04	3.28	2.67	6.09	182.29	49.66	40.42	92.21
8–11*	12 " " " " " "	90.94	12.19	3.48	2.76	5.95	177.36	50.63	40.16	86.57
11–14	12 " " " " " "	89.75	12.11	3.53	2.80	5.78	173.90	50.69	40.21	83.00
14–17	12 " ¼ bran, ¾ rye	92.25	11.86	3.31	2.89	5.66	175.05	48.86	42.66	83.53
17–20*	12 " " " "	88.63	12.07	3.41	3.00	5.66	171.15	48.35	42.54	80.26
20–23*	12 " " " "	88.25	12.15	3.55	2.76	5.84	171.56	50.13	38.97	82.46
23–26	12 " " " "	87·25	12.39	3.67	2.81	5.91	172.96	51.23	39.23	82.50
26–29*	12 " " " "	86.63	12.12	3.39	2.73	6.00	167.98	46.99	37.84	83.15

BETSY.

Date.	Daily Grain Ration.	Milk Yield, 3 Days. lbs.	Percentage of Solids.	Percentage of Fat.	Percentage of Casein.	Percentage of Sugar and Ash.	Yield in Ounces for Three Days. Solids.	Yield in Ounces for Three Days. Fat.	Yield in Ounces for Three Days. Casein.	Yield in Ounces for Three Days. Sugar and Ash.
Jan. 22–25*	6 lbs. mixed meal	77.94	12.13	3.71	2.96	5.46	151.26	46.26	36.91	68.09
25–28	8 " " "	73.44	13.24	4.34	3.20	5.70	155.57	51.00	37.60	66.97
28–31	8 " " "	74.63	13.06	4.31	3.26	5.49	155.94	51.46	38.92	65.56
Jan. 31, Feb. 3*	10 " " "	75.81	13.09	4.50	3.31	5.28	158.78	54.59	40.39	63.80
Feb. 3– 6	10 " " "	77.88	13.11	4.34	3.11	5.66	163.35	54 08	38.75	70.52
6– 9*	12 " " "	73.13	13.27	4.39	3.35	5.53	155.26	51.36	39.20	64.70
9–12	14 " " "	76.56	13.23	4.36	3.26	5.61	162.07	53.41	39.94	63.72
12–15*	14 " " "	67.88	13.01	3.99	3.10	5.92	141.29	43.33	33.67	64.29
15–18	Off feed	39.56	13.99	5.37	3.11	5.51	88.56	33.99	19.69	34.88
18–21	12 lbs. mixed meal	56.31	13.68	4.95	3.07	5.66	123.26	44.60	27.66	51.00
21–24	1st day, 12 lbs. mixed meal, 2d and 3d day, 12 lbs. ¼ corn meal, ¾ mixed meal	67.13	12.90	4.08	3.34	5.48	138.55	43.82	35.87	58.86
24–27	12 lbs. ½ mixed meal, ½ corn meal	68.88	13.15	4.11	3.33	5.71	144.91	45.29	36.70	62.92
Feb. 27, Mch. 2	12 lbs. ¼ mixed meal, ¾ corn meal	63.44	12.76	4.02	3.28	5.46	129.51	40.80	33.29	55.42
Mch. 2– 5*	" " " "	60.00	13.52	4.56	3.42	5.54	129.79	43.78	32.83	53.18
5– 8	" " " "	59.81	13.29	4.30	3.38	5.61	127.19	41.15	32.35	53.69
8–11*	" " " "	57.00	13.33	4.39	3.59	5.35	121.57	40.04	32.75	48.78
11–14	" " " "	47.50	12.83	4.18	3.19	5.46	97.51	31.77	24.24	41.50
14–17	Off feed	37.31	14.02	5.23	3.44	5.35	83.84	31.87	20.57	31.40
17–20	12 lbs. ¼ bran, ¾ rye	48.75	13.39	4.44	3.33	5.62	104.44	34.63	25.97	43.84
20–23*	" " " "	53.31	13.12	4.19	3.57	5.36	112.04	35.78	30.49	45.77
23–26	" " " "	49.56	13.59	4.48	2.59	5.52	107.77	35.53	28.47	43.77
26–29*	" " " "	47.75	13.91	4.93	3.07	5.91	106.27	37.67	23.45	45.15

QUALITY.

Betsy.—The first whole milk sample from this cow January 22-25, was lost. During increasingly heavy mixed meal feeding up to February 14, when the cow went off feed, the quality of the milk showed little variation. Omitting the analysis of milk from February 12-15, taken just prior to going off feed when the cow was feeling poorly and probably gave a poorer grade of milk in consequence, the extremes are hardly beyond the limits of laboratory experimental error.

	Solids.	Fat.	Casein.	Sugar and Ash.
January 25–February 3,	13.13	4.38	3.26	5.49
February 3 " 12,	13.20	4.36	3.24	5.60
Heavier ± lighter.....	+ 0.07	— 0.02	— 0.02	+ 0.11

The cow then did not give a richer quality of milk when more grain was fed of a narrower nutritive ratio.

The time, February 15-27, was used in restoring the condition of the cow and in gradually changing the nature of the grain feed. A daily feed of nine pounds corn meal and three pounds mixed meal was fed from February 27 to March 14, when the cow again went off feed, beginning to show the effect of sickness by a diminished milk yield of poorer quality during the last three days. During this continued feeding of a much wider ration than that fed earlier, quality was irregular but not inferior to that given on mixed meal. Nine pounds of rye and three of bran were fed daily from March 17-29, when one of the cows refused to eat and the test was stopped. The nutritive ratio it will be seen narrows again on this feed and the quality of the milk seems to improve.

	Solids.	Fat.	Casein.	Sugar and Ash.
*Corn and mixed meals,	13.23	4.32	3.42	5.49
*Bran and rye..........	13.37	4.37	3.50	5.50
Bran and rye ± corn and meal......	+ 0.14	+ 0.05	+ 0.08	+ 0.01

Dinah. This cow was of stronger constitution than her mate and continued in good health and appetite throughout the test. She was fed increasingly heavy rations of mixed meal from Jan. 22 to Feb. 22, nine pounds of corn meal, and three of mixed meal from Feb. 27 to March 14, nine pounds rye and three of bran from March 14-29.

On the mixed meal feeding there is at first gain, then loss, and, finally, on the very heavy feeding, gain in quality; the average of the analyses of the first fifteen days when on 6, 8 and 10 lbs. daily feed, and of the last fifteen days when on 12 and 14 lbs. are:

* Omitting last three days in each feeding just prior to going off feed, which, if included, would indicate difference in quality yet more strongly.

	Solids.	Fat.	Casein.	Sugar and ash.
First 15 days	12.00	3.54	2.67	5.78
Last 15 days	12.25	3.56	2.88	5.82
Heavier ± lighter	+ 0.25	+ 0.02	+ 0.21	+ 0.04

It would appear then that on the whole this cow did not change much in quality on increasingly heavy grain feeding.

On the feed of corn meal and mixed meal of which a constant quantity was fed, of a much wider nutritive ratio, quality fell decidedly as compared with what was given on the narrower ration of mixed meal, but remained quite constant during this feeding. When, however, the constant quantity of the narrower bran and rye feed was given the quality again became better.

	Solids.	Fat.	Casein.	Sugar and ash.
Corn and mixed meal	12.02	3.40.	2.75	5.88
Bran and rye	12.12	3.47.	2.84	5.82
Bran and rye ± corn and meal	+0.10	+0.07	+0.09	—0.06

A study of these two tables of averages will indicate that per hundred pounds of Dinah's milk the most solids, fat and casein were given when the most dry matter was eaten; the most fat when the most digestible fat was given; the most casein when the most digestible casein was given, and that the most sugar and ash when the most digestible nitrogenfree extract was eaten. In the case of Betsy, no connection can be traced between the quality of the milk and the food given; fat remained on the whole constant while solids and casein increased as lactation continued.

Daisy. Through a misunderstanding but two analyses were made during the early part of this cow's feeding and the record is too fragmentary to admit of judgment as to quality before the middle of February. Such data as is at hand, however, does not indicate improvement of quality. The cow's refusal to eat cooked cotton-seed meal spoiled the main experiment—the comparative test of raw and cooked cotton-seed meal. On continued bran and gluten meal feeding the quality of the milk improved on bran a little, and on bran and rye yet more as will be seen by reference to the main tabulation.

The quality of these milks may also be studied more roughly from the spaces of cream and pounds of milk per pound of butter. With Betsy and Daisy the quality of milk as determined by chemical analysis and as indicated by the number of pounds of milk producing a pound of fat in the butter is quite uniform there being but two cases in each cow where there is not essential parallelism. In the case of Dinah whose milk varied less in quality than did that of either of the other cows the parallelism is less perfect, there being four cases, in three of which a milk slightly richer in fat, than the one churned previous to it, took

more pounds to make butter containing a pound of butter fat, and in one of which a milk of slightly poorer grade than its predecessor gave better returns. The difference in the fat contents of these milks is so slight as to place these discrepencies quite within the limits of experimental error.

QUANTITY.

Betsy.—The increasingly heavy mixed meal feeding kept Betsy well up on milk flow until she went off feed, but she gave no increase in yield as a return for the excess of food. The effect of the widening ration during the change from mixed to corn meals is shown in the drop in yield. The inability of the corn ration, (nutritive ratio 1:7.9), to keep up milk yield is seen, nor does the somewhat more narrow bran and rye do much better. In general we may say that, eliminating the records made when off feed, this cow shrunk one-third of her yield in two months in spite of heavy grain feeding, and that she gave apparently no more return than she would had she been receiving a normal ration.

Dinah.—The record of Dinah as to milk flow is much more encouraging than that of Betsy. From the day the mixed meal was increased in quantity for one month and until the character of the grain was changed, the cow responded to every added pound of grain by increased yield at the milk pail. As soon however as the wider corn meal ration was fed the milk flow began to shrink and continued so to do until bran and rye was fed, when the flow kept fairly constant.

Daisy.—This cow responded to increased cotton-seed feed by increasing her milk yield to some extent; she did even better on half bran half gluten meal, although probably a wider ration, and shrank on bran and on bran and rye.

YIELD OF SOLIDS, FAT, CASEIN, ETC.

Betsy.—During the increasingly heavy mixed meal feeding this cow appears to have gained somewhat in ounces of solids, fat, casein, sugar and ash. The following is the average yield for three days in ounces for the first half and last half of this feeding, (omitting the records of January 22–25, February 9–12, for reasons before noted).

	Solids.	Fat.	Casein.	Ash.
First half	156.76	52.35	38.97	65.44
Last half	160.23	52.95	39.30	67.98
Heavier ± lighter feeding	3.47	+ 0.60	+ 0.33	+ 2.54

The bulk of the gain seems to have been in the sugar, the least valuable portion of the milk solids. The gains in fat and casein are too slight to have significance. During the continuation of the corn-meal feeding the quantity of all ingredients shrunk.

Average yield of three days: (corn meal)

	Solids.	Fat.	Casein.	Ash.
February 27, March 5...	129.65	42.29	33.06	54.30
March 5–11............	124.38	40.59	32.69	51.23
Later, as compared with earlier	— 5.27	— 1.70	— 0.37	— 3.07

On the bran and rye feed the cow yielded much less than before.

In each case when the cow went off feed she gave much less total yield and less of the various ingredients on her restoration to health than before. It may be said then that this cow gave practically no returns for the excess of food eaten, or, in other words, shrinkage was not arrested by liberal feeding.

Dinah.—The response of this cow with increased quantity of milk when the food was increased has been noted. In the same way to every increase in food the cow responded with increased solids, fat, caseine, sugar and ash. The figures in the tabulation speak for themselves. When the narrower mixed meal ration is put aside for the corn meal, shrinkage in all ingredients takes place, which shrinkage is arrested on feeding bran and rye.

Daisy.—This cow appears from the fragmentary record to increase in quantity of milk ingredients as the meal was increased. She fell off largely on the last three days of her regular bran and cotton seed feeding, which may have been the preliminary of going off feed. At any rate as soon as put on cooked cotton-seed meal the next day she refused it entirely. Notwithstanding she missed one feed her yield of solids returned again to its former amount and remained at high water mark throughout the bran and gluten feed. On bran alone it dropped decidedly, recovering somewhat on bran and rye.

Creaming, Churning, "Churnability," Etc.

The following table gives the necessary data for considering these points. All data are calculated to entire amount of milk given :

	Amount and Nature of Grain Feed.	Weight of Butter 3 Days Milk. oz.	Fat in Skim-milk. %	Fat in Butter-milk. %	Fat in Butter. %	Per Cent of Original Fat Not in Sk. M. and B. M.	Spaces Cream to 1 lb. Butter.	Pounds Milk to 1 lb. Butter.
	BETSY.							
Jan. 22–25	6 lbs. mixed meal	50.9	0.06	0.73	86.45	95.4	6.54	24.5
Jan. 31–Feb. 3	10 " " "	56.0	0.16	0.82	86.31	93.9	6.54	21.7
Feb. 6– 9	12 " " "	56.0	0.03	0.70	86.54	96.4	6.21	20.9
Feb. 12–15	14 " " "	42.8	0.11	0.68	85.77	94.9	6.63	25.3
M'ch 2– 5	12 " { ¼ m'xd meal, ¾ corn meal	45.2	0.03	0.82	83.90	95.8	6.36	21.2
Mc'h 8–11	12 " { ¼ m'xd meal, ¾ corn meal	38.4	0.07	1.77	85.17	90.2	6.71	23.8
M'ch 20–23	12 " { ¼ bran, ¾ rye	36.3	0.22	0.67	86.12	92.9	7.05	23.6
M'ch 26–29	12 " { ¼ bran, ¾ rye	39.3	0.17	0.43	85.44	95.6	5.88	19.4
	DINAH.							
Jan. 22–25	6 lbs. mixed meal	53.7	0.37	0.77	86.76	88.0	5.38	25.3
Jan. 31–Feb. 3	10 " " "	58.5	0.38	0.72	85.60	88.7	5.63	28.0
Feb. 6– 9	12 " " "	62.0	0.35	0.87	85.88	88.2	5.87	27.4
Feb. 12–15	14 " " "	62.2	0.20	0.68	84.83	92.9	5.38	27.5
M'ch 2– 5	12 " { ¼ m'xd meal, ¾ corn meal	53.6	0.22	0.56	85.56	92.1	6.19	30.0
M'ch 8–11	12 " { ¼ m'xd meal, ¾ corn meal	51.2	0.31	0.81	85.01	89.6	5.64	28.4
M'ch 20–23	12 " { ¼ bran, ¾ rye	48.9	0.46	0.73	85.59	86.5	5.95	28.8
M'ch 26–29	12 " { ¼ bran, ¾ rye	45.1	0.64	0.50	85.35	82.3	5.64	30.7
	DAISY.							
Jan. 26–29	6 lbs. mixed meal	34.7	0.83	0.85	86.93	83.0	5.65	24.8
Feb. 3– 6	8 " { ½ bran, ½ C. S. M.	32.7	0.82	1.02	85.79	81.4	6.00	27.1
Feb. 9–12	10 " { ½ bran, ½ C. S. M.	37.1	1.12	1.31	87.79	78.1	5.65	25.7
Feb. 12–18	12 " { ½ bran, ½ C. S. M.	38.2	0.77	0.99	85.02	83.0	5.20	25.5
Feb. 27–M'ch 2	10 " { ½ bran, ½ gluten m'l	41.6	0.49	2.49	84.68	81.5	5.20	24.3
M'ch 5– 8	10 " { ½ bran, ½ gluten m'l	40.4	...	1.52	85.72	...	5.12	23.3
M'ch 11–14	10 " bran	33.3	0.62	0.97	86.60	86.2	6.00	24.3
M'ch 17–20	10 " { ¼ bran, ¾ rye	34.5	0.99	0.81	85.80	80.6	5.83	25.6

Creaming.—It will be noted, that Betsy's milk creams very closely. This is a characteristic of the cow. The fat globules of her milk are larger than those of any other cow in the Station herd, which probably has much to do with the completeness of creaming. The percentage and ounces of fat in the skim-milk of Betsy and Dinah on the various feeds, do not indicate any close connection between them except perhaps in the last two periods, when each cow received bran and rye. It will be noticed that in both periods for both cows, percentage and weights exceed those given on any other feed. It is believed that bran as a food tends to hinder the completeness of creaming, owing to the more fibrinous nature of its product, but the cows received actually less bran than they had been getting in the mixed meal earlier in the test. The indications are that the rye feed was a potent factor in this change, but the data at hand are not conclusive enough to warrant a more positive assertion.

The creaming of the farrow cow's milk, on heavy bran feeding, was poor, as anticipated. Results are too irregular to admit of any definite conclusions being drawn. When bran alone was fed, however, the amount of fat left in the skim-milk was lower than the average, a result not in accord with theory.

Churning.—There does not appear to be any connection between the percent of fat in the butter-milk and the food fed. There seems to be a tendency to lower percentages on the bran and rye feeds, but it is too slight a change to warrant any deduction.*

Butter.—The character of the butter as to fat contents was quite uniform, the extremes of twenty-four samples being 83.90 and 87.79 per cent; of twenty-two, 84.68 and 86. 93 per cent fat. The milk yield is a controlling factor in the weight of fat in the butter of any definite period, and in the absence of marked differences in fat contents of skim and butter-milks, remarks on the effect of food on milk yield would be also applicable to the gross weight of butter-fat.

So far as the so-called "churnability" is concerned, it may be said that with Betsy and Dinah, as the amount of mixed meal feed increased, there appears to be a more perfect "churnability, which was not maintained in Betsy's case on either of the rations fed later, and which was only slightly bettered in Dinah's case on corn meal. No connection whatever can be traced in the "churnability" record of Daisy.

"CHURNABILITY."

6–10 lbs. mixed meal	Betsy,	94.65	Dinah,	88.35
12–14 " " "	"	95.65	"	90.55
Corn and " "	"	93.	"	90.85
Bran and rye	"	94.05	"	84.40

*It was intended to churn only after the cow had had the increased grain for a period of from one to three days, but through an error at the Station farm some of the earlier churnings were made without such preparation, as the location of the asterisks in the tabulation of yield, etc., will show.

SUMMARY.

On a ration, the grain of which was mixed meal, fed in quantities gradually increasing from 6 to 14 lbs. daily for twenty-four days, one cow gave about the same quantity of milk throughout, of quite even quality, and gained slightly on the gross weight of milk ingredients as the grain feed increased and the nutritive ratio narrowed. This gain, however, was made almost wholly on the milk sugar.

Another cow responded to every additional pound of meal with an increased milk yield of better quality, all milk ingredients particularly the casein, increasing largely.

On fifteen days continuous feeding of a ration the grain of which was three pounds mixed meal and nine pounds corn meal daily, a much wider ration than the mixed meal previously fed, the first cow shrank decidedly in yield and in all milk ingredients, particularly in fat and sugar contents and gave irregular quality which, however, was not inferior to that given on mixed meal. The other cow shrank in yield and all solid ingredients and in quality, which, however, remained constant throughout the feeding.

On continuous feeding for periods of twelve, fifteen and six days respectively, of a ration the grain of which was three pounds bran, nine pounds rye, daily, a somewhat narrower ration than the one preceding it, the first cow recovering from being off feed at the close of the corn meal feeding, continued to drop in milk yield, increased in gross weight of fat produced, decreasing in other respects, and improved decidedly in quality over that given on corn meal; a second cow held her milk yield and its solid contents fairly constant, improving somewhat in quality; a third cow, (farrow), shrunk slightly in milk yield as compared with bran feeding, giving however improved quality and more gross weight of solid milk ingredients.

A farrow cow on a ration containing equal quantities of bran and cotton-seed meal, in amounts gradually increasing from six to twelve pounds, during sixteen days, gave slight increase in yield of about the same quality. She absolutely refused to eat cooked cotton-seed meal. On continuous feeding of a ration containing five pounds bran and five pounds gluten meal for nine days, an increased yield was given together with a better quality, and more milk solids than at any time previous. On a daily ration of ten pounds bran, for six days, yield and solid ingredients dropped, quality improved.

One cow, (Betsy), kept getting off her feed and shrank one-third of her milk yield in two months, being the second and third after calving. Another, (Dinah), responded to every change in food. The farrow cow responded fairly well and died of over feeding.

The milks creamed less successfully on bran and rye than on any other feed, a fact which held good with all three cows. As they had less

bran then than before, if the effect is due to food the rye must have been a controlling factor. The farrow cow gave the richest skim-milk. No connection between food and fat contents of buttermilk could be traced.

The butter was of even quality as regard fat percentages, the "churnability" (so called), seems to become better as the mixed meal feed increased, dropping again on corn and bran and rye in the case of Betsy, and becoming yet better on corn and much lower on bran and rye in the case of Dinah. No relation between food and churnability could be found in the case of Daisy.

In general it may be said, that the limit of ability to assimilate a heavy grain feed and to respond in milk product is dependant upon the individual physical constitution and nervous temperament of the animal. Up to this limit there appears to be no unfavorable effect upon the animal or its products. The financial success of such methods must depend largely upon the make-up of the animal and the relative cost of concentrated feeds.

COMPARATIVE EFFECTS OF HAY, OF ENSILAGE AND OF CORN FODDER, AS FED TO MILK COWS.

BY J. L. HILLS.

Late in November, 1889, the entire station herd was put upon a ration the coarse fodder of which consisted of hay. About two weeks later the coarse fodder of all was changed, five cows being then given cut corn ensilage, and seven cut corn fodder. They were kept on these latter rations two weeks. Each of these fodders was of good average quality and the cows were allowed to eat all they wanted. During these four weeks frequent analyses of the milk of each cow were made, each sample for analysis being the mixed product of six milkings. The weight of the whole milk yield of each cow was recorded daily, analyses made of each day's skim-milk, and an analysis of the butter-milk from each churning. We have thus data for the comparison of the effects of these different coarse fodders.

In the following comparisons the conclusions are drawn in all cases from the records of the last six days of each of the two periods.

During the last six days on hay, four fall cows, none shrinking in milk to any great extent, gave 388.22 pounds of milk containing 4.40 per cent or 273.09 ounces of fat. During the last six days, on ensilage, the same cows gave 353.89 pounds of milk containing 4.41 per cent, or 249.56 ounces of fat. The quantity of milk dropped on ensilage more than the natural shrinkage of the cows will account for; the quality remained practically unchanged.

Individually two cows improved in quality, one deteroriated, and one remained stationery. All shrank in quantity about equally.

During the last six days on hay, another set of four cows, consisting of two fall cows, one farrow cow, and one late spring cow which did not begin to dry off until January, gave 392.12 pounds of milk containing 5.18 per cent, or 321.54 ounces of fat. During the last six days, on cut corn fodder, the same cows gave 357.31 pounds of milk containing 5.09 per cent, or 290.92 ounces of fat.

Another set of three spring cows fast drying off, (all being dry early in February) gave on hay 275.94 pounds of milk containing 4.85 per cent, or 214.27 ounces of fat. The same cows on cut corn fodder, gave 201.56 pounds of milk containing 5.22 per cent, or 168.23 ounces of fat. Individually all of the cows placed on corn fodder shrank in quantity of milk. Of the first set on corn fodder, two gave a poorer quality, one the same, and one better than when on hay. Of the second set, or spring cows, two gave much richer milk and one the same quality after the change. Summing up in a single sentence the comparative results from cows on hay and corn fodder,—the first set of four cows shrank on corn fodder both in quantity and quality more than natural shrinkage will account for, while the second set of three, which were already drying off, naturally shrunk in quantity and gained in quality. It is noticeable, however, on reviewing the milk yield of these three cows from the time when marked shrinkage began until they dried off, that the shrinkage was more decided on this than on any other coarse fodder fed during the winter.

The milk of all of the cows was run through the separator and the percentages of fat left in the skim-milk were determined continuously from the beginning of the last six days of the test on hay through the whole period of feeding on ensilage and corn fodder.

They are as follows :

Hay:—0.16—0.27—0.19—0.19—0.26.

Ensilage and corn fodder:—0.21—0.33—0.39—0.31—0.31—0.25—0.39—0.34—0.36—0.39—0.36—0.23—0.36—0.37.

There are two breaks in the record due to lost samples.

The average of the six days on hay is 0.21 per cent, of the first eight analysis on ensilage and corn fodder 0.32 per cent, of the last six days analyses, 0.35 per cent.

The fat percentage of the skim milk from hay is noticeably less than that from the other fodders. The same man ran the separator throughout the experiment.

The results as to "churnability" are too indeterminate to admit of reliable conclusions being drawn.

SUMMARY.

I. Ensilage gave less milk than hay, the quality being the same.

II. Corn fodder gave less milk and a little poorer quality than hay, when the cows were not naturally drying off. In the case of the three cows that were drying off, the corn fodder gave very much less milk of a much richer quality, and the shrinkage was much more marked when on corn fodder than when on any other coarse fodder fed during the winter.

III. Creaming seemed better on hay than on the other fodders.

IV. Churning did not vary essentially.

V. Hay was therefore the best milk producing food of the three. No attempt was made however to study the financial side of the question.

LIGHT AND HEAVY MEALS.

BY J. L. HILLS.

In the fall of 1889 a test of the relative effects of light and heavy meals on milk and butter production was carried out essentially as follows:

Eleven cows were divided into three groups (I—two spring, one farrow cow ; II and III—two spring, three fall cows, each). They were daily fed during one period 10 lbs. apple pomace, 3 lbs. wheat bran, 3 lbs. buckwheat middlings, and green barley, rather ripe, (per cent dry matter), *ad libitum* (I and II), and the same amounts of pomace and barley with 6 lbs. mixed meal (seedage) (III). During the other period they received 10 lbs. apple pomace, 3 lbs. corn meal, 1½ lbs. each of cottonseed and linseed meals and hay and corn fodder *ad libitum* (I and II), and the same amounts of pomace and barley with 6 lbs. mixed meal (III). The whole milk of each cow in the first two groups was analyzed throughout the test, the milk of each group separately set, creams separated, churned, and all samples of skim and buttermilks and butters analyzed, all samples being taken after preliminary feeding had accustomed the cows to the change of feed.

The first ration was succulent, the second dry ; the first, because of its bran, middlings and barley, according to the theory of increased fibrine from bran feeding, should have creamed poorly. The heavy meal ration was fed at a disadvantage as regards lengthening periods of lactation.

The comparison based on the average daily yield of each group is as follows:

	I.			II.		
	Pounds Milk.	Per Cent Fat.	Ounces Fat.	Pounds Milk.	Per Cent Fat.	Ounces Fat.
Bran ration	61.25	4.16	40.70	62.32	5.51	54.92
Corn ration............	58.20	4.07	37.88	56.67	5.55	50.29
Bran ± corn....	+ 3.06	+.009	+ 2.82	+ 5.65	—0.04	+ 4.63

These shrinkages are more than normal. The heavy meals and dry food gave less milk of no better quality than the lighter meals did when combined with succulent food. Reference to the comparison of bran and corn meal in the article on heavy feeding of grain (p. 75), will show the same to have been true when bran was fed after corn meal.

Individually, on the heavy meal ration, one cow gave more and better, one less and better, five less and the same or poorer milk.

Is this falling off due to the change in meal, coarse food, or to both? Let us turn to group III. No analyses were made of whole milks and we can only judge by milk yield. The average daily yield on green barley was 74.40 lbs.; on hay and corn fodder, 73.28 lbs., two cows increasing, two decreasing in yield on the change. This drop is not as marked as with the other cows, the inference being that probably the change of meal had more to do with the shrinkage than the change of coarse fodder.

The results on creaming and churning are as follows: Each fat percentage being the mean of two or more analyses of as many samples, composite in the case of skim-milks, single in the case of butter-milks.

	I.	II.		III.	
Bran ration....	0.82....	1.24	Succulent ration....	0.93	Creaming.
Corn ration....	0.51....	0.79	Dry ration..........	0.67	
Bran ration....	0.66....	0.38	Succulent ration....	0.50	Churning.
Corn ration....	1.01....	0.75	Dry ration..........	0.72	

The pounds of milk and spaces of cream to a pound of butter were:

	I.	II.		III.
Bran ration....	25.20....	19.55	Succulent ration....	25.05
Corn ration....	24.15....	17.30	Dry ration	22.00
Bran ration....	6.44....	6.14	Succulent ration....	5.45
Corn ration....	6.68....	6.28	Dry ration..........	5.70

The milks from the bran rations appear to have creamed less successfully and taken more milk to the pound of butter, but to have thrown up a denser cream, churning better and taking less spaces to the pound of butter.

The milk from the green barley feed seems to have acted much the same way. The butters were quite uniform in fat contents, the extremes of twelve analyses being 77.93—81.24 per cent of nine out of twelve 78.82—79.78 per cent fat. Hence the general relation of pounds of milk and spaces of cream to the pound of butter fat is the same as to the pound of butter.

The test in general may be said to indicate that *such light foods as bran are often as good, weight for weight, as heavier meals for quantity and quality of milk, and to add testimony to the belief that milks from such feeds cream less thoroughly than those from heavier meals.*

MILKING TWO AND THREE TIMES PER DAY.

BY J. L. HILLS.

It has been claimed that within certain limits the more often a cow is milked the more milk and milk solids she will give. If it were shown that a third milking gave any noticeable increase in product it might pay some dairymen to milk at noon in addition to the usual morning and night milkings.

Two tests of this claim have been made at this Station, which may be said to have indicated that *a third milking will not pay as a regular farm practice.*

The first test, on a farrow Ayrshire, was planned as follows: Mornings and night's milk were separately sampled and analyzed for three days, milking taking place at 5 A. M. and 6 P. M., then the cow was milked for three days, thrice a day at 5 A. M., 1.30 P. M., 8 P. M., samples being similarly taken from each milking. Some weeks later, having been milked but twice a day since the former test, similar samples were taken for eight days on two milkings per day, and then the cow was milked for two weeks thrice a day before the remainder of the samples (eight days) were taken. In this way both temporary and permanent effects could be measured. A second test on a registered Jersey fresh in milk, were similarly executed, except that the two trials were combined and the third set of samples taken two weeks later than the second, the cow having been milked three times daily between them.

On this test samples were taken for six, three and four days respectively. Neither cow was shrinking in milk yield to any extent at the time of testing.

The following table gives the average daily yield under each condition and its average composition, and the yield in ounces of solid ingredients, also the average composition and yield of morning, noon and nights' milk. It embodies the results of thirty-four analysis of as many samples.

Test.	M'lkn'gs per Day.	Days Between two and three Milking Samples.	Time.	Milk Yield.	Total Solids.	Fat.	Casein.	Milk Sugar and Ash.	Total Solids.	Fat.	Casein.	Milk Sugar and Ash.
				lbs.	%	%	%	%	oz.	oz.	oz.	oz.
I.	2		Entire Day,	15.94	13.22	4.62	3.32	5.28	33.70	11.78	8.47	13.45
I.	3	0	"	18.14	12.87	4.33	3.35	5.19	37.36	12.58	9.71	15.07
				+2.20	—0.35	—0.29	+0.03	—0.09	—3.66	+0.80	+1.24	+1.62
I.	2		"	19,48	13.36	4.46	3.39	5.51	41.64	13.89	10.57	17.18
I.	3	14	"	17.48	13.39	4.40	3.36	5.63	37.45	12.32	9.39	15.74
				—2.00	+0.03	—0.06	—0.03	+0.12	—4.19	— 1.57	—1.18	—1.44
II.	2		"	25.77	14.18	5.43	3.34	5.41	58.45	22.39	13.77	22.29
II.	3	0	"	25.38	14.20	5.01	3.44	5.75	57.67	20.36	13.98	23.33
				—0.39	+0.02	—0.42	+0.10	+0.34	—0.78	—2.03	—0.21	+1.04
II.	3	14	"	25.05	14.25	5.21	3.28	5.76	57.12	20.88	13.16	23.08
				—0.72	+0.07	—0.22	—0.06	+0.35	—1,33	—1.51	—0.61	+0.79
I.	2		Morning	10.46	13.26	4.53	3.34	5.39				
	2		Night	8.05	13.40	4.50	3.41	5.49				
	3		Morning	7.65	12.37	3.57	3.47	5.33				
	3		Noon	5.49	14.09	5.20	3.29	5.60				
	3		Night	4.52	13.43	4.69	3.29	5.45				
II.	2		Morning	13.22	13.80	4.84	3.24	5.72				
	2		Night	12.55	14.52	6.00	3.44	5.08				
	3		Morning	11.00	13.71	4.54	3.42	5.75				
	3		Noon	7.35	15.13	5.95	3.40	5.78				
	3		Night	6.84	14.08	5.09	3.23	5.76				

A study of the table brings out the following points: *Less milk* was given when the cow was milked three times a day, in three trials out of four; in the fourth a marked increase in gross yield followed the change as soon as made, but the second test of the same cow indicated that the effect was only temporary and that continuance brought about a positive decrease.

The *quality of the milk* of the whole day was *always lowered* by milking three times a day. The fat percentage invariably dropped more or less, the sugar and ash on the whole increasing and the casein remaining unchanged. Since *less milk of poorer quality* was given when the cows were milked thrice daily, it follows that there were less solid ingredients.

In the case of the exception noted above, however, there was a temporary increase of solids as a result of more though poorer milk.

Under both conditions the cows gave the most milk at the earliest milking and less at each subsequent milking during the day. When milked but twice a day, one cow gave the same quality at both milkings, the other a milk at night that was richer in fat and poorer in sugar than the morning's milk. When milked thrice daily, each cow gave the most and poorest milk in the morning, less of the richest milk at noon and the least of a medium quality at night. In these fluctuations of quality the fat only is concerned, the casein, sugar and ash on the whole remaining constant.

It would seem then that *as a regular farm practice there is nothing to be gained from an extra daily milking to repay its cost, although with some cows as a temporary means for increasing milk flow it might prove of use.*

MECHANICAL LOSSES IN HANDLING MILK.

BY J. L. HILLS.

In the report of the Maine Agricultural Experiment Station for 1889, pages 130–132, there is an article on "the relation of the total fat in the milk to the butter obtained." In the course of their work they found a discrepency; the total weight of fat in the whole milk was not accounted for in the products (cream and skim-milk, or butter, skim and butter-milks). In the above named article the inquiry is made, "Is it an *actual* loss of fat?" and no answer is given.

A similar inconsistency had been observed at this Station early in its history, and investigations into its nature and amount made. A number of separate trials have been made at various times on quantities of milk varying from the daily yield of a single cow to the daily receipts of large creameries by different persons, creamerymen, farmers and chemists, and with varying degrees of care.

As a result of these tests we are led to believe that this loss is *mechanical* in its nature and *due to the greater viscosity of cream as compared with skim-milk*, causing it to stick to pails, churns, butter-workers, etc, and so bring about many minute losses. These losses count up heavily in per cent of the entire fat present (entire fat = 100%) on small batches of milk, but almost disappear, calculated upon the same basis, when large quantities are used. If this loss were an *actual* one, a positive destruction of fat as such, due to chemical, bacteriological or other causes, it is difficult to see why such destruction should not be exerted to as great an extent proportionally in a large as in a small batch, times, temperatures and conditions other than bulk being equal.

In several trials the Station has made complete analyses of all the materials, including milk, butter, skim and butter-milks and sundry slops. The tests were in general as follows: A carefully weighed amount of milk was creamed or separated, cream and skim-milk weighed, cream churned, butter and butter-milk weighed, everything from beginning to end carefully sampled and analyzed. The weights of the various materials multiplied by the per cents of ingredients found in them furnish the comparative data, and if there was no loss and no error in weight or analysis the sum of the parts (butter, skim and butter-milks and slops) should equal the whole (milk). But such loss *does* occur in the fat, and fat, originally present in the whole milk, is not found in any of the products.

Generally speaking, **the casein and milk sugar and ash have checked out within close limits** the sum found in the products being sometimes more, sometimes less, than that present in the whole milk, and the "*solids not fat*" *also have checked out closely*, the difference being but once in six trials more than one per cent of the entire solids not fat. *In nine out of ten trials, however, the sum of the fats found in the butter and waste products has been less than that in the original milk, and generally much less*, while the exception is only 0.23% over the line on more than four hundred and fifty pounds of butter. At the Maine Station much the same thing was found, large losses of total solids which were almost entirely fat, the losses of solids not fat averaging but three-quarters of one per cent on the entire solids not fat, present.

This loss of fat has been found in our trials to decrease with increased weights of milk and greater care and to increase with smaller amounts of milk and lessened care.

Note in the following table the large per cent losses of fat in tests A and B (small quantities of milk) and E (ordinary care), the small per cent loss in G and actual gain in F (large quantities of milk)and the small loss in D (medium quantity of milk and extreme care). [Test C is an exception ; on but twenty-three pounds of milk a minute loss of fat and large losses of casein and sugar and ash. This is so different from other tests as to indicate some error in sample or analysis].

BRIEF DESCRIPTION OF TESTS.

A. B. C. Day's yield, one cow; deep cold setting; test by Station Director and chemist; made with more than ordinary care.
D Station herd milk for two days; separator; test by Station Director and chemist; made with extreme care.
E Station herd milk for two days; deep cold setting; test by Station dairyman, without knowledge of the nature of the test except that he was to take extra accurate weights.
F. & G. Creamery daily receipts; separator; test by creamery men, without knowledge of the nature of the test.
Samples in tests A B C D F and G taken by Station chemist; E, by Station dairyman.

Milk Ingredients in	Milk Feed. lbs.	Total Solids. oz.	Solids not fat. oz.	Fat. oz.	Caseine oz.	Milk Sugar and Ash. oz.
Whole Milk.	31	78.205	45.104	33.101	17.228	27.876
Butter & Wastes		76.738	45.534	31.204	17.287	28.247
	A.	−1.467	+0.430	−1.897	+0.059	+0.371
		−1.88%	+0.55%	−5.73%	+0.34%	+1.33%
Whole Milk.	23.13	50.557	34.280	16.277	11.968	22.312
Butter & Wastes		48.864	32.788	16.076	11.446	21.342
	C.	−1.693	−1.492	−0.201	−0.522	−0.907
		−3.35%	−2.96%	−1.24%	−4.36%	−4.35%
Whole Milk.	378.70	784.77	524.73	260.04	208.68	316.05
Butter & Wastes		770.70	525.08	245.62	211.68	313.40
	E.	−14.5	+0.35	−14.42	+3.00	−2.65
		−1.80+	+0.04	−5.54%	+1.44%	−0.84%

Milk Ingredients in	Milk Used. lbs.	Total Solids. oz.	Solids not Fat. oz.	Fat. oz.	Caseine oz.	Milk Sugar and Ash. oz.
Whole Milk.	24.44	58.343	36.356	21.987	14.168	22.188
Butter & Wastes		57.324	36.241	21.083	13.830	22.411
	B.	−1.019	−0.115	−0.904	−0.338	+0.223
		−1.75%	−0.20%	−4.11%	−2.39%	+1.00%
Whole Milk.	291.18	598.666	400.198	198.468	141.630	258.568
Butter & Wastes		596.905	402.086	194.819	144.323	257.763
	D.	−1.761	+1.888	−3.649	+2.697	−0.805
		−0.29%	+0.32%	−1.84%	+1.90%	−0.81%
Whole Milk.	10.473	†651840		*5091	+308960	
Butter & Wastes		6533.04			3058.72	
	F.	+15.24		G.	−30.88	
		+0.23%			−1.00%	

* Milk used pounds,
† Fat oz.

The Station records of this year also afford thirty-two other comparisons of a similar nature. These tests were not made with any intention to measure this loss or to reduce it to a minimum, but were included in three series of experiments reported in this volume. They were conducted with ordinary care only and without the precautions that were used in some or the refinement of care that was used in one of the tests already cited. Moreover, the settings of milk were small (about 20 pounds to a setting), several settings making the test, circumstances favorable to increase of loss. In these thirty-two tests but once did the fat in the butter and wastes equal that originally taken in the milk. In this case a decided plus (+ 4.70%) indicates error. In the other thirty-one on quantities of milk ranging from 41.56 to 158.74 (and one 216.69) pounds, fat from— 2.95 to — 16.65 ounces equivalent to — 4.91% to — 13.56% is missing. The averages of these are 114.64 pounds milk,— 7.72 ounces fat, equivalent to — 8.17% of entire fat missing. Although not of the value of the tests made with greater care and for the express purpose of determining the nature and amount of this loss, they are of use as confirmatory evidence.

In this connection it might be well to note the large weights in fat unaccounted for at the Maine Station as given in their report (*loc. cit.*) The nature of the experiments under way caused the handling of large numbers of comparatively small quantities of milk, a circumstance favorable to loss. Thus the milk of the cow Jansje contained while under experiment 340.4 pounds fat, of which 32.5 pounds, or 9.55%, were unaccounted for in either skim or butter-milk or in the butter; Nancy Avondale, 208.8 pounds, of which 20.5 pounds, or 9.82%, were unaccounted for; Queen Linda, 245.9 pounds, 27.9 pounds, 11.35%, respectively; Agnes, 352 pounds, 46 pounds, 13.07%, and Ida 237.8 pounds, 39.7 pounds, 16.70%. Also to two other tests made with more than ordinary care by this (Vermont) Station on 171.13 and 519 pounds of milk, which were slightly faulty in a single detail, but probably nearly accurate, which show but 2.65% and 2.06% of fat unaccounted for.

These results naturally group themselves as follows. Note how with more milk and more care per cent losses decrease:

Amount of Milk.	Care.	Percentage of Entire Fat Unaccounted for.
Small	Ordinary	8.17 (average 31 tests), 9.55, 9.82, 11.35, 13.07, 16.70
Small	More than ordinary	5.73, 4.11,
Medium	Ordinary	5.54
Medium	More than ordinary	2.65, 2.06
Medium	Extraordinary	1.84
Large	Ordinary creamery usage	+ 0.23, 1.00

In discriminating between degrees of carefulness "ordinary" care is to be understood to be such care as a Station dairyman used to experimental work would naturally use in such work, being more than "ordinary creamery usage" and less than "more than ordinary" which included the immediate supervision of a chemist.

It is difficult to conceive how some of these losses can have taken place mechanically. For instance test D was conducted by the director of the Station and the writer, with the utmost precaution and painstaking care to prevent all loss of material. Weights were checked by two persons, duplicate samples taken of everything after careful mixing and each analyzed in triplicate, making six determinations of each ingredient in each material. Every avenue of mechanical loss was closed so far as possible, and yet in spite of all nearly two per cent of the fat or three and two-thirds ounces in two hundred and ninety pounds of milk failed to appear in the products. On the other hand, however, the creameries working on more milk showed much greater *gross* discrepancies but far less *percentage* differences.

The tests here reported include all the Station has made, except one which was vitiated by an error, and we claim them to be strong evidence that this loss is a purely mechanical one. Losses of fat in skim and butter-milks are known to dairymen, but we think the extent of mechanical losses due to handling small quantities of milk, be that handling ever so careful, has not been fully understood. It certainly is one more argument in favor of the economy of working with large amounts of milk.

SUMMARY.

Tests made at this Station indicate: that

I. In handling milk for the making of butter there is more or less loss of the solid material, shown by the fact that the sum of the solid milk ingredients found in the products (butter, skim and butter-milks and slops) is not equal to the amount in the whole milk taken; that

II. This loss falls almost entirely on the fat, the "solids not fat," casein, milk sugar and ash in the products checking fairly well with those in the original milk, while the fat does not; that

III. This loss of fat is inversely proportional to amounts of milk used and care taken in its handling, decreasing in percentage of entire fat (entire fat=100 per cent) as the amounts used increase and with greater care; that

IV. This last fact indicates that the loss does not arise from any chemical or bacteriological cause, but is purely mechanical, due to the greater viscosity of cream as compared to skim-milk. If the former cause existed it might be expected to bring about as great proportional destruction in large as in small batches of milk.

RELATION OF FAT AND CASEIN IN MILK.

The records of this Station contain a large number of analyses of milk from different cows, from the same cows at different periods of their milk flow and from different dairies. The whole of our own data has been worked over to obtain the results given below, *and also all the analyses of milk that give both fat and casein, that have been published by all the experiment stations in the United States.* In all somewhat over two thousand four hundred analyses. On studying the analyses of the milk of individual cows, it will be seen at once that the proportion between the fat and casein is widely different. The extremes in this direction are represented by the following analyses: No 1 represent a registered Jersey, and Nos. 2 and 4 registered Holsteins, and No. 3 a grade Jersey. Each of these analyses is the average of four consécutive milkings, on the same date with the cows on the same feed in the same barn.

	Total Solids.	Fat.	Casein.	Milk Sugar and Ash.	Solids not Fat.
1. Jersey	16.26	6.68	4.24	5.34	9.58
2. Holstein	15.31	4.88	4.38	6.05	10.43
3. Jersey	14.59	5.05	3.61	5.93	9.54
4. Holstein	13.17	4.15	4.04	4.93	9.02

These analyses are unusual in the following points: No. 1, low in milk sugar and ash ; No. 2, very high in casein, and also in sugar and ash, and in solids not fat; in other words it is very low in fat for the amount of total solids. No. 3 is low in casein as compared with fat, and No. 4 is the direct opposite and also very low in milk sugar and ash. Nos. 2 and 4, both of which are Holsteins, represent the extreme possible limits of variation in milk sugar and ash.

In No. 1, the casein is 63 per cent of the fat; in No. 2, it is 90 per cent; in No. 3, it is 71 per cent, and in No. 4, it is 97 per cent.

If these analysis were any criterion of the average character of the milk of the two breeds, they would seem to indicate that the milk of the Jersey is better adapted to butter making than to cheese making, while the Holstein milk is well proportioned for the manufacture of cheese. So sweeping a conclusion can hardly be drawn from so slight premises, but on examining several hundred analyses of cows of different breeds, the conclusion is found to be the same. In the three milk breeds, the Ayshire, Holstein and Shorthorn, the casein will average about 90 per cent as much

as the fat, while in the two butter breeds, the Jersey and Gurnsey, the casein will average rather under than over 75 per cent of the fat.

From these analyses it is evident that the *average* relation of fat and casein can be obtained only by the comparison of a large number of cows. This has been done and the figures given later are the results of this comparison. They were obtained as follows: All the analyses available that showed total solids between 11.00 per cent and 11.50 per cent were averaged and give the first line, 11.35, 3.20, etc.; those between 11.50 and 12.00 were averaged for the next and so on. Each of these figures represents a very large number of analyses; for instance, the sixth line is the average of more than 400 analyses, and some of the others represent as large a number. As would be expected the two extremes are the average of a smaller number of samples than those nearer the middle.

SUMMARY.

Total Solids.	Fat.	Casein.	Milk Sugar and Ash.
11.35	3.20	2.99	5.16
11.77	3.36	3.03	5.38
12.21	3.60	3.10	5.51
12.75	3.82	3.29	5.64
13.17	4.09	3.40	5.68
13.71	4.46	3.48	5.77
14.25	4.87	3.65	5.73
14.77	5.20	3.87	5.70
15.17	5.47	4.07	5.63
15.83	5.88	4.26	5.69

From these figures by calculation can be found the amounts of the ingredients that correspond to the even quantities of total solids as follows:

Total Solids.	Fat.	Casein.	Milk Sugar and Ash.
11.00	3.07	2.92	5.01
11.50	3.29	3.00	5.21
12.00	3.50	3.07	5.43
12.50	3.75	3.19	5.56
13.00	3.99	3.30	5.71
13.50	4.34	3.44	5.72
14.00	4.68	3.57	5.75
14.50	4.93	3.79	5.68
15.00	5.38	4.00	5.62
15.50	5.69	4.15	5.66
16.00	6.00	4.30	5.70

There is quite a regular increase from first to last in everything except the sugar, which increases decidedly at first until the total solids reach 13.00 per cent and then remains practically constant, no matter how much the other solids increase.

The especial thing to be noticed is the relative increase of the fat and the casein. The casein does not increase so fast as the fat, that is when fat increases one per cent, the casein does not also increase one per cent, nor does the casein increase relatively as fast as the fat, *i. e.* when the fat doubles the casein does not also double, for instance when the fat changes from 3.00 to 6.00 per cent, casein instead of doubling, does not increase quite one-half in amount.

This can be shown in tabular form as below :

Total Solids.	Fat.	Casein.	Relation of Casein to Fat. %
11.00	3.07	2.92	95
12.00	3.50	3.07	88
13.00	3.99	3.30	83
14.00	4.68	3.57	76
15.00	5.38	4.00	74
16.00	6.00	4.30	71

Above 16.00 per cent total solids and below 11.00 per cent there are not many analyses on record, but what there are seem to indicate that below 11.00 per cent, the fat falls rapidly and becomes less than the casein, while above 16.00 the milk sugar remains constant, the casein scarcely increases, and nearly all of the extra solids is composed of fat. It can be said then in general that nature tries to keep casein as much as possible between 3.00 and 3.50 per cent, decreasing more slowly than fat and sugar, in poor milk, and increasing less than half as fast as fat in rich milk.

It will be interesting to see what proportion of the whole total solids is fat and what casein in the different qualities of milk. This can be most easily shown by letting 100 represent the total solids.

Total Solids.	Fat.	Casein.	Milk Sugar and Ash.
11.00 = 100	28	26	46
12.00 = 100	29	25	46
13.00 = 100	31	25	44
14.00 = 100	33	25	42
15.00 = 100	36	26	38
16.00 = 100	38	26	36

Each of these parts follows a distinct rule. The most remarkable is the casein, which keeps surprisingly close to one-fourth of the total solids. It can be said then that normal milk, whether rich or poor, has on the average one-fourth as much casein as total solids, though single samples may depart widely from this standard. As the milk becomes richer the fat becomes constantly a larger part of the total solids, while the milk sugar as constantly becomes proportionally smaller.

CREAM RAISING BY DILUTION—DEEP AND SHALLOW SETTINGS.

BY J. L. HILLS.

A series of experiments in gravity creaming were carried out by this Station in June and July, the results being published in Newspaper Bulletin No. 3, and in a leading dairy paper. A second series of much the same nature has been made during the winter of 1890–91, under the direction of the writer by the following first year students in the Agricultural Department of the University: Messrs. F. H. Brown, J. V. Clifford, E. K. Hill, C. N. Mead, H. K. Peltekian, A. B. Selian, William Stuart and F. C. Talcott, the tests forming a portion of the class instruction in dairying. Details in dairy-room and laboratory were largely in their hands, and analyses (gravimetric and "Beimling,") were generally made by them, results being frequently checked by parallel determinations by the Station chemists. As newspaper articles are fugitive in their nature, both series of tests will be reported here:

The experiments were designed to test whether successful gravity creaming could be obtained without the use of ice and to cover the systems in use in the State, deep settings in water and in air and shallow air settings in large and small pans. The Cooley can was used for the first two and shallow tins for the second two. The summer trials were made at the Station farm, while those in the winter were made at the Station building in the city.

I. Deeep Setting in Water.

The creaming tests of the summer of 1890 were all made by this system. The short ice crops of the two preceding winters had shown the need of some modification of deep setting, that would produce successful creaming with the use of little or no ice.

It has long been known that milk in deep setting at 55-60° F. does not cream thoroughly, and that to obtain good results either a lower temperature or a lessened depth of milk (shallow setting) must be used, the one calling for large quantities of ice, the other for larger tanks and better and more expensive milk rooms than are generally found on our farms. The

usual course in deep, cold setting is to place the milk immediately after milking in water at 40-45° F., thus giving a theometric fall of from 40-55° according to the season. Claims have been made that if milk be heated above its normal temperature at milking, it could be successfull creamed at a correspondingly higher degree, that is to say that a degree fall in temperature is of equal value for creaming purposes wherever located on the scale of the thermometer. It has also been stated that if the milk be warmed by the addition of hot water, the two factors, favorable to creaming, thinned milk and wider range of temperature would be combined, that the tank water need not be cooler than 58-60°, thus doing away with ice to a large extent, and that as thorough creaming would be obtained as by the use of ice in quantity. The experiments under this head were planned to test these claims.

The tests were carried out as follows. The mixed milk of three sets of cows was used and, finally, that of all the Station herd at once. For convenience they may be designated as I (Grade Holstein, Durham and Guernsey—all calved in December, 1889;) II, (Grade Ayrshires—spring cows;) III, (Grade Jerseys—spring cows,) and IV, (Station herd.) Settings were made night and morning, skimmed at twenty-four hours, and all skim-milks, fifty-six in number, analyzed for fat.

The tests, four in number, lasted nine, six, nine, and four days respectively. In the first two sets of cows, I and II being used, in the third, I and III, and in the fourth IV.

The measure of the efficiency of a creaming process properly conducted, other things being equal, is the percent of fat left in the skim-milk. The following table shows this data (the analytical results on diluted milks being calculated to the undiluted state) together with details of settings, and the ounces of fat lost from the setting of 100 pounds of milk under the conditions of each test. Each per cent of fat given is the average of three analyses of as many samples.

	Day of Test.	Milk Cooled or Warmed to °F.	Cooled or Warmed in.	Mixed with ⅛ Bulk of Hot Water at °F.	Set at °F.	In Water at °F.	Range of Temperature °F.	In Favor of.
I.	1.4.7	85	Air.	—	85	45	40	Warm 2°
	2.5.8	100	Hot Water.	—	100	58	42	
	3.6.9	85	Air.	135	100	58	42	
II.	1.3.5	—	—	—	97.75	45	52.75	Cold 4.25°
	2.4.6	96	—	135	105.5	57	48.5	
III.	1.4.7	—	—	—	97.4	44.5	52.9	Cold
	2.5.8	—	—	—	96.75	58	38.75	6.°1
	3.6.9	96.25	—	135	105.8	59	46.8	14.°15
IV.	1.2.3.4	95.25	Air.	—	95.25	45	50.25	Warm 1.°75
	1.2.3.4	110	Hot Water.	—	110	58	52	

Set of Cows.	Cold Setting.	Warm Setting.	Warm Diluted Setting.	Cold Setting.	Warm Setting.	Warm Diluted Setting.	Cold ± Warm Diluted.	Cold ± Warm.
	Per Cent Fat in Skim-milk.			Ounces Fat in Skim-milk.				
I. { I.	0.70	1.06	0.86	8.62	13.83	11.22	—2.60	—5.21
I. { II.	0.29	0.61	0.60	3.21	8.35	7.96	—5.75	—5.14
II. { I.	0.60	——	0.60	7.56	——	7.93	—0.37	——
II. { II.	0.20	——	0.18	2.49	——	2.32	+0.17	——
III. { I.	0.64	1.24	0.68	9.31	17.34	9.17	+0.14	—8.03
III. { III.	0.27	0.43	0.20	3.12	5.25	2.55	+0.57	—2.13
IV.—IV	0.37	0.74	——	4.66	9.63	——		—4.97

The results of the first trial are open to the objection that there was delay between milking and setting, which it is thought, affected creaming unevenly and to the disadvantage of the warmer settings. Excluding this test the warm diluted settings did as good work as the cold settings, the balance being slightly in favor of the former to the extent of 0.13 oz. more fat recovered from 100 lbs. milk. Including it, the balance favors cold setting, 1.14oz. more fat recovered from 100 lbs. milk. The warm undiluted setting failed as compared with cold setting in each of five trial, and but once equalled the diluted setting. Special precautions were taken to prevent scalding, the formation of fibre clots and against the solution of lactic acid, etc., by the ether in the analysis of sour samples.

A somewhat similar set of experiments to those just detailed were published in the fall of 1890 by the Cornell Station (Bulletin). Results were obtained which seem at variance with those published by this (Vermont) Station in Newspaper Bulletin No. 3, and a repetition of our work was made as stated at the opening of this article.

In many ways the conditions of the second test were unsatisfactory, the temperature of the creamer being poorly controlled through misunderstanding, the work being mainly done by students unaccustomed to experimental methods, and thus being more or less delay in setting. During the latter part of the test a man experienced in the work of milk setting was associated with them and the quality of the creaming improved.

The cows used were three in number,—full blood Holstein and Jersey,

and all far along in milk. The tests included deep cold setting, the addition of an equal bulk of cold water to the milk and setting cold, the addition of a third bulk of hot water and setting cold, the addition of pounded ice in large and in small pieces and of snow to milk and setting cold. There were seven tests of the first, six of the second, eight of the third, six of the fourth, and five of the fifth, and twenty-two analyses.

AVERAGES ARE AS FOLLOWS:

	Temperature of Milk.	Temperature of Dilutant, °F.	Temperature of Milk when Set.	Temperature of Water in Creamer.	Range of Temperature.	Per cent Fat in Skim-milk (Corrected for dilutant.)
Deep cold setting, undiluted	—	—	86	44	42	0.72
Deep cold setting, diluted with equal bulk cold water	°85	°50	°67.5	°44	°23.5	°1.03
Deep cold setting, diluted with $\frac{1}{3}$ equal bulk hot water	83	132	95.5	43	52.5	0.95
Deep cold setting, diluted with $\frac{1}{4}$–$\frac{1}{3}$ weight ice	88	32	42	44.5	+2.5	0.72
Deep cold setting, diluted with $\frac{1}{4}$–$\frac{1}{3}$ weight snow	87	32	33	45.	+12	0.79

Although, through misunderstanding, the range of temperature favored warm setting decidedly, it does not do as well as deep cold setting. It is thought, however, that this is not of necessity a fault of the method. There is more manipulation and there was more delay in the warm diluted setting than in the others. When an experienced hand took hold of the work the quality of all the creamings improved very much and that from warm diluted setting became as good as any other.

In this connection it may be well to show the effect on creaming of the inexperienced and experienced work.

Deep cold setting, first four tests........1.03 % fat, last three, 0.31% fat.

Equal bulk cold water, first four tests..1.36 % " " two, 0.38% "

$\frac{1}{3}$ equal bulk hot water, first six tests...1.15 % " " " 0.33% "

$\frac{1}{3}$ " weight ice, first two tests..........1.04 % " " four 0.56% "

$\frac{1}{3}$ " " snow, first three tests.....1.08 % " " two 0.32% "

The tables are of value, as showing that the addition of snow and ice to milk producing sudden chill, gave good creaming, that the addition of cold water in equal bulk, causing quick cooling part way and slow cooling the rest of the way down to 45° did not do as well, and the value of rapid work in milk setting. There seemed to be no difference in result whether the ice used for diluting was small or large.

II. DEEP SETTING IN AIR.

Tests were made by this system in connection with the class work, by the students named, with results expressed in averages, as follows. Tests were six, five and three in number respectively:

	Temperature of milk.	Temperature of Dilutant.	Set at	In Air, at	Range of Temperature.	Per cent Fat in Skim-milk (Corrected for dilutant).
Deep setting, undiluted	°81	—	°81	°43	°38	°1.03
Deep setting, diluted with equal bulk cold water	80	53	65	40	25	0.96
Deep setting, diluted with ¼ bulk hot water	78	130	90	42	48	1.04

There is but slight difference in these results, and such as appears has little significance. The warm diluted setting in air, although favored in the number of degrees fall of temperature, does not do any better than the others, and that method which caused the poorest creaming when set in water did best when set in air.

III. SHALLOW SETTING IN AIR.

Each setting, when the milk was set in these tests, lasted forty-eight hours, and at no time did it sour. Samples of skim-milk for analysis were taken with a pipette. Four tests of each method of setting in each style of pan were made with averages as follows:

	Temperature of Milk.	Temperature of Dilutant.	Set at	In Air, at	Range of Temperature.	Per Cent Fat in Skim-milk (Corrected for Dilutant.
Small pans, shallow setting, undiluted	°89	—	°89	°47	°42	°0.40
Small pans, shallow setting, diluted equal bulk cold water	74	47	60	46	14	0.55
Small pans, shallow setting, diluted ½ bulk hot water	87	115	93	45	48	0.31
Large pans, shallow setting, undiluted						0.47
Large pans, shallow setting, diluted equal bulk cold water						0.66
Large pans, shallow setting, diluted ½ bulk hot water						0.50

In shallow settings, then, it would appear that diluting with cold water causes loss, and diluting with hot water, little gain over undiluted setting.

It will be noted that the best creaming results, as a whole, obtained in the winter tests, were by shallow settings at a low temperature. Whether as good could be attained at a temperature high enough to render skimming practicable is doubtful. There were even more delays in setting in this, than in the deep setting work, yet the effect of delay does not show itself as markedly. When, however, the deep setting was properly handled, it gave the better results.

Which of these various methods show promise? The heating of milk by external means and setting at 58–60° resulted in loss as compared with ice or hot water, and the latter proved as easy and practicable as any other means of heating. Dilution with cold water gave inferior results, and entails the disadvantages of doubled tank capacity, and a skim-milk so thin as to be almost useless for feeding purposes. Ice and snow did well in deep setting, and the former would probably prove of value in summer, causing effective creaming at a considerable saving of ice. As between cold and warm diluted settings, deep and shallow, the testimony of the two series of tests seems to show equally good work by both processes; each being properly handled, that the warm diluted setting is more liable to be mis-

managed and that it seems to suffer more proportionally from mismanagement than cold setting does.

Among the practical questions arising in connection with these results, are: If a farmer has running water at about 58°, is there sufficient gain to be expected from the use of ice or hot water to pay for the extra cost and trouble? If so, which method is generally preferable?

The first query admits of but one answer. In a dairy of twenty cows producing during June, July and August, about 500 lbs. of milk per day, the skimmilk will weigh about 375 lbs. If these 500 lbs. of milk were set directly at 50°, the loss in fat will approximate $375 \times 0.82 = 3.08$ lbs. fat. If, however, it was set af 45°, or diluted with hot water and set at 58°, the loss would be in the vicinity of $375 \times 0.41 = 1.54$ lbs. fat. The saving by use of ice or hot water would be $3.08 - 1.54 = 1.54$ lbs. butter fat, or the equivalent of nearly two pounds of butter, which would much more than repay labor and fuel or ice.

As between the use of cold or hot water, circumstances should decide. It is probable that the quality of the butter would not vary essentially when made by either method, properly handled. Hot water would generally prove the cheaper, but its use entails some serious disadvantages. The dilution of the milk necessitates a third larger tank capacity. The feeding value of the skimmilk is much lessened, especially for calves. But the most serious difficulty lies in the fact that the cream from warm diluted setting sours with great rapidity. In the Station tests we had one case in which the cream was sour when skimmed, twenty-four hours after setting, and in every case it was so nearly sour that six or eight hours after skimming it was ready to churn. This is no objection to the farmer who churns daily, but is a serious matter to one churning three times and an insurmountable obstacle to the man who churns only twice a week. The same reason prevents the use of hot water by those who patronize cream gathering creameries, as the cream would be quite sure to sour on the road in the gatherer's can and to be too sour before churning time arrived. Moreover, the creams from cold and warm diluted settings are so different in their nature, that their mixture, as would take place in creamery work, would cause bad churning and large losses of fat in the buttermilks.

It might be well to note in this connection that to the farmer selling by the "space" system to creameries, there is positive loss to be expected from the use of hot water, as such diluted milk throws up a much more close and dense cream, which while actually containing the same weight of butter-fat, would not measure by some spaces per can as much as that thrown up by the use of ice water. Attention is called to this fact, otherwise the farmer, judging by the spaces alone, might be led to think that the use of hot water was resulting in loss of cream. A creamery raising its

own cream by gravity process and churning daily by itself the cream so raised, might find the hot water treatment advantageous.

The results of these tests may be summed up as follows:

1. The usual method of deep cold setting does as effective work as any gravity creaming process and does not carry with it some disadvantages of other methods.

2. The addition of snow or pounded ice to the milk in the deep can causes good creaming, perhaps as effectual as by the usual method.

3. The direct heating of milk by external means and setting at 58-60° and the dilution of milk with large bulks of cold water and setting at any degree produced relatively poor creaming whenever used by any of the systems.

4. The heating and increased fluidity of milk caused by adding from a quarter to a third its bulk of hot water (130-150° F.), produced on the whole as effectual creaming when set in water at 58-60° or shallow in cool air, as was the case with ordinary settings, but it entails the serious disadvantages of increased tank room, thinner skimmilk and a rapidly souring cream.

5. There seems little preference in the use of hot or cold water or of none at all in deep air settings.

6. In cool shallow setting nothing was gained by dilution either hot or cold.

7. Delays in settings and manipulations of the milk prior to setting seem to affect the creaming of the deep setting more than that of the shallow setting systems.

EFFECT ON THE QUANTITY AND QUALITY OF MILK OF THE CHANGE FROM BARN TO PASTURE.

BY J. L. HILLS.

In the last report of this Station (1889) the results of a study of the effects on milk of the change from barn to pasture were given, being summarized as follows: "One season's experience indicates the following as true for the Station herd: In changing from barn to pasture feed of equal feeding value, the *quality* of milk changes differently in different animals, there being usually a gain in per cent of solids, casein and sugar, and a loss in per cent of fat; the gross amounts of the ingredients almost invariably increase. Animal individuality plays so large a part in the marked change from barn to pasture feeding that the statement of the nature of the change in quality should not be understood to be of general application. Further work in this line is being carried out by this Station." (3rd Rep. Vt. Exp. Stat., p. 83.)

A 'similar investigation was made on a broader scale in the spring of the current year (1890). Samples and weights of the milk of six spring and six fall cows and from four dairies ranging in size from thirteen to twenty-one (spring) cows, all dry fed in the barn, were taken both when on barn and on pasture feed and the milks analyzed. Four cows which calved in the late fall and early winter, belonging to the Station herd, were barn fed in such a manner as to give, as nearly as might be, a ration of the same nutritive ratio as they would probably get on pasture, and their milks sampled and analyzed when on both feeds. From four to six weeks inter vened between the samples taken on barn and pasture feeding which favored the former. All samples were taken by Station authorities.

The following tables show *milk yields, analyses* and *yield of solid constituents of the average cow for the average day of each period,* the *first* representing the *four Station cows*—calving in the fall—*equally well fed in barn and on pasture ;* the *second, six fall cows,* and the *third, eighty-one spring cows, whose dry barn feed was less nutritious than the pasture.* It may be well to state that ninety-one cows, one hundred and seventy-six samples of milk and forty complete milk analyses contribute to this table.

	Milk Yield. lbs.	Total Solids. %	Fat. %	Casein. %	Milk-sugar and Ash. %	Total Solids. oz.	Fat. oz.	Casein. oz.	Milk-sugar and Ash. oz.
Barn	17.51	12.46	4.12	3.02	5.32	34.87	11.53	8.45	14.89
Pasture	22.28	13.08	4.14	3.14	5.80	46.62	14.75	11.20	20.67
Pasture + Barn	+4.77	+0.62	+0.02	+0.12	+0.48	+1175	+3.22	+2.75	+5.78
Percentage of Gain	27.2	.50	0.5	4.0	9.0	33.7	27.9	32.6	38.8
Distribution of Gain		100.	3.'	19.	78.	100.	27.	24.	49.
Barn	12.87	14.53	5.26	3.42	5.85	29.91	10.82	7.04	12.05
Pasture	14.17	15.10	5.72	3.61	5.77	34.23	12.97	8.18	13.08
Pasture+ Barn	+1.30	+0.57	+0.46	+0.19	—0.08	+4.32	+2.15	+1.14	+1.03
Per cent of Gain	10.1	3.9	8.8	5.6	—1.4	14.4	19.9	16.2	8.6
Distribution of Gain		100.	81.	33.	-14.	100.	50.	26.	24.

Barn..........	15.64	12.12	3.69	2.93	5.50	30.33	9.23	7.33	13.77
Pasture.......	24.32	12.83	3.83	3.32	5.68	49.94	14.90	12.91	22.13
Pasture + Barn	+8.68	+ 0.71	+0.14	+ 0.39	+ 0.18	+1961	+5.67	+5.58	+ 8.36
Per cent of Gain.......	55.5	5.9	3.8	13.83	3.3	64.7	61.4	76.1	60.7
Distribution of Gain		100.	20.	55.	25.	100.	29.	29.	42.

A study of this table, of the data on which it is based, and of last year's test, brings out the following points:

In this year's test in every case, increase in total milk yield and in gross weight of every solid milk constituent follows the change from barn to pasture, even though a month later in lactation, while increase in percentage of total solids and casein always, of sugar and ash nine times and fat seven times out of the eleven. Last year's results were similar as regards quantity, but variable in respect to quality. They were obtained, however, from individuals, receiving about the same amount of nutriments in both barn and pasture periods, while this year's test was mainly on herds having more and better feed in the pasture than when in the barn.

In passing from barn to pasture, the spring cows responded most in quantity of milk yield, milk solids and fat, increasing them fifty-five, sixty-five and sixty-one per cent, respectively; the fall cows bettered their yield but ten per cent; the solids but fourteen, their fat but twenty per cent; and the well fed early winter cows, in spite of their previous good feeding, bettered their milk yield and fat a little more than a quarter, and their solids a third. In *quality* of milk the fall cows made the most, the spring cows less and the Station cows little or no improvement in passing from barn to pasture. Such gross increase as was made in solids by the fall cows was half of it fat, while but a little over a fourth of that made by the other two sets of cows was fat.

Two of the four Station cows and one herd dropped in fat — 0.18%, 0.34% and 0.05% respectively or 4.8, 6.9 and 1.5% of the fat present in the milk on barn feeding.

The other two Station cows gained 0.21% and 0.30% or 4.5 and 7.9% of the fat. In last year's test on eleven individual cows, seven lost, three gained and one did not change in fat percentage, maximum and minimum being + 0.27 and — 0.73.

During these tests the milk of the four Station cows was separately set and skimmed, creams separately churned and all skimmilks, buttermilks and butters, fifty-six in number, were analyzed for fat. The results have been incorporated in the article on "churnability" in this report.

There was little difference in creaming—the mean of sixteen analyses being :

Skimmilk—Barn feed, 0.45%; Pasture feed, 0,41%. This slight difference is believed to be without significance. There seemed to be no dis-

tinctive characteristics to the butter-milks and butters from the two classes of feed and the "so-called" "churnability" on the whole favored the barn feeding.

In general it would appear that *cows under the usual Vermont conditions of dry barn feed when turned to pasture may be expected to give more and richer milk, the increase in flow being greatest in new milch cows and the increase in richness greatest in those farther along in lactation, but both quantity and quality increasing more or less in almost every case. When, however, cows pass from a barn to a pasture ration of equal feeding value, more milk, generally richer in total solids, casein and sugar and sometimes richer sometimes poorer in fat is usually given, which affords increase in gross yield of all milk constituents.*

The results of these tests and of many other changes from dry to succulent foods which have been controlled by chemical analysis have warranted us in stating the general rule that *pasture feeding and watery food does not make watery milk.*

MISCELLANEOUS NOTES ON DAIRY WORK.

BY W. W. COOKE.

EFFECT OF CHURNING AT DIFFERENT TEMPERATURES.

The cream of six milkings was thoroughly stirred and divided. The first part was churned at 67° and the rest at 57.°

Temperature of Churning.	Time of Churning. Minutes	Cream. lbs.	Added Water. lbs.	Butter. lbs.	Butter-milk. lbs.	Per cent of Fat in Butter-milk.	Per cent of Fat in Butter-milk without the Added Water.	Weight of Butter for 100 lbs. of Cream.
67°	9	49.75	16.5	11.25	55.00	0.52	0.74	22.5
57°	36	55.50	45.0	13.13	87.57	0.21	0.43	23.7

There was a gain, then, of 0.31 per cent of fat less lost in the butter-milk at 57° than at 67.°

EFFECT OF STAGE OF STOPPING THE CHURN ON THE QUALITY OF THE BUTTER-MILK.

A churning was stopped when the grains were very fine, and a sample of butter-milk drawn out and strained through a fine brass wire sieve. The mass in the churn was then at a temperature of 67°, water was added at 52°, reducing the temperature of the cream to 63°, and the churning was continued until the butter was in large grains and just beginning to gather. A second sample of butter-milk was then taken and strained through the same sieve. The first sample contained 0.77 per cent of fat, and the second sample 0.52 per cent fat. This second sample calculated back to butter-milk free from water would be 0.74 per cent fat. So there is in this experiment but 0.77 — 0.74 = 0.03 per cent fat difference in favor of adding water and churning until butter is really gathered.

SAMPLING BUTTER-MILK.

On finishing churning one day at the farm, the first quart of butter-milk drawn off was saved and analyzed, and also the last quart. The first gave 0.38 per cent of fat, and the last 0.38. So that in this case the last butter-milk was no richer than the first.

SKIMMING COOLEY CANS.

The skim-milk from some Cooley cans was drawn until there were eight spaces of skim-milk left. The skim-milk drawn off so far was analyzed. The rest of the skim-milk was then drawn off until but two spaces were left of the skim-milk in the can. This was also analyzed. The first sample containing 0.41 per cent of fat, the second 0.59, showing that the skim-milk next to the cream is considerably richer than that in the rest of the can.

CHURNING MIXED CREAM.

Some months ago an article appeared in an agricultural paper by a prominent writer in which the statement was made that if sweet cream was mixed with sour cream just before churning, the acid cream would sour the sweet cream, and both lots of cream would come to butter at the same time. Since then an article by Dr. Babcock in the report of the Wisconsin Station says that this is not true, but that what will happen is that each cream will churn just as it would if it had been churned alone. For example, if one-half of a lot of sweet cream was churned by itself leaving a butter-milk containing 1.20 per cent of fat, and one-half of a like quantity of sour cream churned by itself gives a butter-milk containing 0.40 per cent fat, the first theory would say that if a mixture was churned of the other half of each of these creams, the resulting butter-milk would contain 0.40

per cent of fat, while Dr. Babcock's theory requires the butter-milk to have 0.80 per cent fat.

To test both these theories several churnings were made. In the first test 20 pounds of sweet cream was churned by itself at a temperature of 68°; 20 pounds of sour cream was churned by itself at the same temperature; then 20 pounds of each of these creams were churned together at the same temperature. The sweet cream left 2.24 per cent of fat in the butter-milk; the sour 0.62, and the mixed 0.92 per cent fat.

The same was tried again 34 pounds being used of the sweet, 17 pounds of each for the mixture of sweet and sour, and 76 pounds for the sour cream. These three churnings were made at a little lower temperature than the first set. The butter-milk from the sweet cream contained 1.77 per cent fat. Sour cream 0.25 per cent, and from the mixed creams 1.17 per cent.

The third trial was made at the much lower temperature of 52°. There were 20 pounds each of the sweet and sour mixed for one churning; 58 pounds sweet cream by itself, and 60 pounds sour cream by itself. The butter-milk from the sweet cream had 0.68 per cent fat, from the mixed cream 0.66 per cent, and from the sour cream 0.16 per cent.

It will be noticed that these figures do not bear out either theory. None of them agree with the first theory, since in every case the mixed creams do not churn so well as the sour cream. Neither do the results agree very well with Dr. Babcock's theory. In the first case the theory requires 1.43 per cent fat for the mixed cream and we got 0.92; in the second case the theory calls for 1.01 and 1.17 was obtained, while the third test gave us 0.66 against a theoretical 0.42. The average of the three tests is as follows:

Sweet cream	butter-milk,	1.56	per	cent	fat.
Sour cream	"	0.34	"	"	"
Mixed "	"	0.92	"	"	"

The mean of the sweet and sour cream butter-milks is 0.95 per cent, and the mixed cream 0.92, a very close agreement. It seems then that the tests separately do not seem to bear out Dr. Babcock's theory, but the averages of the three tests together are in close agreement with his theory. But at any rate it can certainly be said that *there is always a loss from the mixing just before churning of creams of different degrees of ripeness.*

ADDING SODA TO MILK.

The milk of the herd for six milkings was mixed and divided; thirty pounds each time was set in deep cold setting with the addition of one-half ounce of caustic soda dissolved in a little water; the remainder of the milk was set without soda under the same conditions.

The cream from each of these lots was churned separately while sweet. Samples were taken of the skim-milk and butter-milk.

Skim-milk from cans	with soda,	0.57	per cent	fat.
" " "	without "	0.30	"	"
Butter-milk from cream	with soda,	1.30	"	"
" " "	without "	0.72	"	"

This hardly shows, as has been claimed, that the soda aids in the creaming of the milk. The test is directly the reverse.

The butter from the cream with soda had a soapy taste and was not of good quality. Perhaps had this cream been allowed to ripen thoroughly, the acid developed would have neutralized the soda and have gotten rid of the peculiar taste.

ADDING ICE WATER TO MILK.

One of the theories to account for the rapid rising of the cream in cold setting is that the cold retards the coagulation of the fibrin and thus allows the cream to rise. If this is the reason, then it would seem that if the milk can be rapidly cooled before being set in the tank the cream should rise still more thoroughly.

To test this, 20 per cent of ice water was added to the warm milk and then set in cold deep setting. One half of the milk was set in this manner and the other half with nothing added. The skim milk from each was analyzed. That from no water added gave 0.45 per cent fat. When ice water was added the skim-milk gave 0.51 per cent, but as there was much more skim-milk when the ice water was added than when it was not, the real per cent of the skim milk would be about one-third more, or 0.68. The cream from each of the skimmings was churned separately, and the butter-milk from that to which nothing was added gave 0.33 per cent fat. That to which ice water was added, 0.54. So there was loss both in the skim-milk and the butter-milk from the addition of ice water. This result would seem to indicate that the cold is needed around the outside of the milk rather than in it to obtain the best results.

PIG FEEDING.

BY W. W. COOKE.

During the summer of 1889, an experiment in pig-feeding was conducted at this station, and the results published in Bulletin No. 18, an abstract of which is presented in the earlier part of this volume. The experiment was repeated the summer of 1890, and an account of it follows. The experiment was planned to determine the following points

QUESTIONS ASKED.

1. Which of several breeds grows the fastest.
2. How much food is required for this growth.
3. Which breed make a pound of pork the cheapest.
4. How much food is required to make a pound of pork during the different periods of life.
5. How long can pigs be kept and yield a profit above the value of the food consumed.
6. Value of skim-milk fed to pigs.
7. Fertilizing value of food fed to pigs.
8. What is the effect of heavy feeding of corn meal to full grown pigs.
9. The relative value of wheat middlings and corn meal as food for young growing pigs.
10. The relative value of rice bran and corn meal for growing and fattening pigs.

ANSWERS RECEIVED.

In brief the conclusions reached were that in this particular trial:

1. The Chester white grew the fastest.
2. The Chester white and the Poland China required the most food.
3. The large Yorkshire made a pound of pork with the least cost of food.

But it should be remembered that as showing the relative value of different breeds a single test should carry but little weight, since there is a much larger difference between the different individuals of the

same breed than between the average of a large number' of individuals of each of the different breeds. The question of breed was considered as of secondary importance in this test, though it was considered that the results of the averages would be more reliable when obtained from individuals of several breeds than if all the pigs had been of one breed.

4. On the average the six pigs required during the first period 1.59 lbs. of dry matter in the food to make a pound of growth, and this amount increased steadily as the pigs increased in live weight, until during the last period when they weighed about 200 lbs. apiece, it required 3.96 lbs. of dry matter in the food to produce a pound of growth,

5. The pigs ceased to yield a profit at the market prices then ruling, after they reached a live weight of about 180 pounds. But

6. It was found profitable then to feed them heavily for fifteen days on corn meal to "finish them off" for market.

7. In every case corn meal gave better results than wheat middlings as food for young growing pigs.

8. In every case corn meal gave better results than rice bran, producing on the average about a quarter more growth with the same amount of food.

HISTORY.

The pigs used in this trial were of four breeds: Poland China, from Page Ufford, Fairfax; Large Yorkshire, from the Vermont Insane Asylum, Brattleboro; Small Yorkshire, from L. S. Drew, Burlington, and Chester White, from Dr. J. M. Clark, Burlington. The experiment began May 12, with all except one of the Small Yorkshire that did not arrive until May 19. The pigs were about of the same age, two months, and were fed the same, the feed in general consisting of six quarts of skim-milk per day and three-quarters of a pound of either corn meal or middlings. This was given each day of the test. As the pigs grew older, whatever more food they wanted was made up of a mixture of one part by weight of wheat

bran to two parts of gluten meal. The pigs were fed all they wanted, or rather all they could be induced to eat.

DAILY RATIONS OF PIGS.

A, Large Yorkshire and D, Small Yorkshire.

Period.	Date.	Skim-milk. qts.	Corn Meal. oz.	Bran and Gluten Meal. oz.
I.	May 19—May 26	3	6	
	May 26—June 11	6	12	
II.	June 11—June 21	6	12	
	June 21—July 2	6	12	12
	July 2—July 12	6	12	24
	July 12—July 22	6	12	40
III.	July 22—September 1	6	12	48
IV.	September 1—September 20	6	12	48
	September 20—October 3	6	12	56

B, Large Yorkshire and C, Small Yorkshire.

Period.	Date.	Skim-milk. qts.	Wheat Middlings. oz.	Bran and Gluten Meal. oz.
I.	May 12—May 26	3	6	
	May 26—June 11	6	12	
II.	June 11—June 21	6	12	
	June 21—July 2	6	12	12
	July 2—July 12	6	12	24
	July 12—July 22	6	12	40
III.	July 22—September 1	6	12	48
IV.	September 1—September 20	6	12	48
	September 20—October 3	6	12	56

E, Poland China. F, Chester White.

Period.	Date.	Skim-milk. qts.	Corn Meal. oz.	Bran and Gluten Meal. oz.
I.	May 12—May 26	3	6	
	May 26—June 11	6	12	
II.	June 11—June 21	6	12	12
	June 21—July 2	6	12	24
	July 2—July 12	6	12	40
	July 12—July 22	6	12	48
III.	July 22—September 1	6	12	56
IV.	September 1—September 20	6	12	64
	September 20—October 3	6	12	72

GAIN IN LIVE WEIGHT BY PERIODS.

A. Large Yorkshire.				B. Large Yorkshire.				C. Small Yorkshire.			
Period.	Live Weight at Beginning of Period.	Live Weight at End of Period.	Gain in Live Weight During Period.	Period.	Live Weight at Beginning of Period.	Live Weight at End of Period.	Gain in Live Weight During Period.	Period.	Live Weight at Beginning of Period.	Live Weight at End of Period.	Gain in Live Weight During Period.
I.	19	52	33	I.	20	43	23	I.	24	52	28
II.	52	100	48	II.	43	96	53	II.	52	95	43
III.	100	160	60	III.	96	151	55	III.	95	144	49
IV.	160	206	46	IV.	151	194	43	IV.	144	180	36

D. Small Yorkshire.				E. Poland China.				F. Chester White.			
Period.	Live Weight at Beginning of Period.	Live Weight at End of Period.	Gain in Live Weight During Period.	Period.	Live Weight at Beginning of Period.	Live Weight at End of Period.	Gain in Live Weight During Period.	Period.	Live Weight at Beginning of Period.	Live Weight at End of Period.	Gain in Live Weight During Period.
I.	17	40	22	I.	32	57	25	I.	25	60	35
II.	40	92	52	II.	57	113	56	II.	60	125	65
III.	92	148	56	III.	113	169	56	III.	125	188	63
IV.	148	192	44	IV.	169	211	42	IV.	188	228	40

GAIN IN LIVE WEIGHT DURING TEST.

Breed.	No. of Days.	Total Gain. lbs.	Average Daily Gain. lbs.
A. Large Yorkshire..	145	187	1.29
B. Large Yorkshire..	145	174	1.20
C. Small Yorkshire..	145	156	1.08
D. Small Yorkshire..	138	174	1.26
E. Poland China.....	145	179	1.23
F. Chester White	145	203	1.40
Total............	863	1073	1.24

It will be seen from this that the Chester White pig grew the fastest.

TOTAL AMOUNT OF FOOD EATEN.

Breed.	Skim-milk. quarts.	Corn Meal. lbs.	Wheat Middlings. lbs.	Bran and Gluten Meal. lbs.
A. Large Yorkshire	812	102.75	......	274.25
B. Large Yorkshire	812	......	102.75	274.25
C. Small Yorkshire	812	......	102.75	274.25
D. Small Yorkshire	791	100.33	......	274.25
E. Poland China	812	102.75	......	357.50
F. Chester White	812	102.75	......	357.50
Total	4,851	408.58	205.50	1812.00

The Chester White and the Poland China therefore ate the largest amount of food.

FOOD REQUIRED TO PRODUCE A POUND OF GROWTH.

Breed.	Total Dry Matter Fed. lbs.	Total Gain in Live Weight. lbs.	Dry Matter Eaten for One Pound Gain in Live Weight. lbs.
A. Large Yorkshire	499.52	187	2.67
B. Large Yorkshire	499.52	174	2.87
C. Small Yorkshire	499.52	156	3.20
D. Small Yorkshire	493.86	174	2.83
E. Poland China	573.23	179	3.20
F. Chester White	573.23	203	2.82
Total	3138.88	1073	
Average	523.15	178.91	2.92

The tables show that on the whole the Large Yorkshire produced growth the most economically, though the differences between the Large Yorkshire, the Small Yorkshire and the Chester White are scarcely enough to require attention.

4. RELATION OF WEIGHT AND FEED.

As pigs grow larger they grow faster, but they also eat more, and the appetite increases so much faster than the size of the animal that the amount of food eaten for each pound of growth steadily increases and consequently the cost of producing that growth. This is shown plainly in the accompanying table taken from the averages of the six pigs previously mentioned.

Period.	Average Weight at End of Period. lbs.	Average Daily Gain in Live Weight During Period. lbs.	Average Daily Amount of Dry Matter in Food Consumed During Period. lbs.	Average Amount of Dry Matter in Food Consumed for Each Pound Increase in Live Weight. lbs.	Average Cost of Food Consumed for Each Pound Increase in Live Weight. cents.
I.	**51**	1.20	1.91	**1.59**	**2.47**
II.	**104**	1.28	3.16	**2.47**	**3.70**
III.	**160**	1.40	4.65	**3.32**	**4.89**
IV.	**202**	1.31	5.12	**3.96**	**5.82**

In other words it requires more than twice as much food to produce a pound of growth in a two hundred pound pig as it does to produce the same growth in one weighing only fifty pounds.

The practical part of the whole work comes then in the answer to the question as to how long this can continue before the cost of the food will more than equal the selling price of the pork.

5. RELATION OF WEIGHT AND PROFIT.

The answer to the above question will be found by comparing the selling price of the pork with the cost of the food used in each period to produce it. The corn meal, gluten meal and wheat middlings used each cost us $26.00 a ton and the wheat bran $24.00 a ton. The skim-milk was from our own dairy, and was considered as worth fifteen cents per hundred pounds or one and one-third cents per gallon. These prices are used in calculating the cost of the feed consumed by the pigs.

The pork was sold at five cents a pound, dressed weight.

Period.	Average Weight at the End of the Period. lbs.	Average Cost of Food Consumed to Each Pound Increase in Live Weight. cents.	Selling Price Per Pound Live Weight. cents.	Average Gain Per Pound Increase in Live Weight. cents.	Total Gain of Live Weight During Period. lbs.	Total Profit During Period.
I.	**51**	2.47	5.00	**2.53**	166	**$4.20**
II.	**103**	3.70	5.00	**1.30**	317	**4.12**
III.	**160**	4.89	5.00	**0.11**	339	**.37**
IV.	**202**	5.82	5.00	**0.82***	251	**2.06***

* Loss.

It is evident from this that the pigs were kept at a loss during the fourth period. At the end of the third period, when they averaged weighing 160 lbs., they were still yielding a profit, though a small one, while during the fourth with a weight of 202 pounds there was a positive loss. There would have been the most profit in selling them at somewhere between these two points, probably about 175 to 180 pounds live weight.

The cost of feed and the price of pork are both higher than the average for several years previous and it will be interesting to see whether these conclusions hold good for ordinary prices. During 1889 corn meal, gluten and middlings were purchased for $18.00 a ton and bran for $16.00 and the pork was sold for 4.32 cents per pound. Using these prices we get the following results:

Period.	Average Weight at the End of the Period. lbs.	Average Cost of Food Consumed to Each Pound Increase in Live Weight. cents.	Selling Price Per Pound Live Weight. cents.	Average Gain Per Pound Increase in Live Weight. cents.	Total Gain of Live Weight During Period. lbs.	Total Profit During Period.
I.	**51**	2.20	4.32	**2.12**	166	**$3.51**
II.	**103**	3.03	4.32	**1.29**	317	**4.09**
III.	**160**	3.78	4.32	**0.54**	339	**1.83**
IV.	**202**	4.45	4.32	**0.13***	251	**.33***

* Loss,

The result remains the same, that at 160 pounds weight there was still profit and at 202 pounds weight loss. These results are the same in substance as those obtained in our trials of 1889, and thus give increased assurance of the correctness of the conclusions.

6. HEAVY FEEDING WITH CORN MEAL.

During these four periods the pigs had been fed a ration that would grow the bones and muscles as well as produce fat enough to keep them in good condition. The account of debit and credit showed that this method of feeding could not profitably be continued, but the question arose whether these pigs could be "finished off" on corn meal for a few days without further loss. Accordingly all other grain was taken away and they were given the six quarts of skim-milk a day as before and all the clear corn meal they would eat. They gained rapidly in weight, but at the end of fifteen days of this treatment they showed signs of getting off feed and of a lack of strength in the legs, indicating that the experiment had reached practicable limits and it was brought to a close. The financial side of this "finishing off" process can be learned from the tables.

DAILY RATIONS OF PIGS.

Date.	Skim-milk. qts.	Corn Meal. lbs.
Oct. 3— 8	6	4
Oct. 8—13	6	6
Oct. 13—18	6	8

Pig.	Live Weight, Oct. 3. lbs.	Live Weight, Oct. 18. lbs.	Total Gain in Live Weight. lbs.	Total Value of Food Eaten.	Value of Food Eaten for each Pound Gain in Live Weight. cents.	Selling Price, per pound, Live Weight. cents.	Gain per pound of Increase in Live Weight. cents.
A.	206	2[illegible]8	42	$1.47	3.50	5.00	1.50
B.	194	236	42	1.47	3.50	5.00	1.50
C.	180	221	41	1.47	3.59	5.00	1.41
D.	192	234	42	1.47	3.50	5.00	1.50
E.	211	245	34	1.47	4.32	5.00	0.64
F.	228	268	40	1.47	3.68	5.00	1.32
Average	202	242	40	$1.47	3.68	5.00	1.32

Average gain per day, 2⅔ pounds.

It is evident that these pigs paid a profit for these few days "finishing off" with corn meal, and it is probable that the profits would have been a little larger if the stuffing process had been commenced earlier, and thus occupied the time from 175 to 200 pounds when they were being fed at a loss.

Had this last period been figured at $18.00 a ton for corn meal, and 4.32 cents a pound for pork, it would have left a net gain of **1.59** cents per pound live weight.

FINANCIAL SUMMARY.

These pigs on the whole, while we fed them, gave a profit over the cost of the food they ate. They made a total gain in live weight of **1313.5** pounds which sold for **$65.67**, while the food they ate cost **$55.76**, a profit of **$9.91**.

VALUE OF SKIM MILK.

The above result is figured at the assumed value of 15 cents per 100 pounds for skim-milk. After taking out the cost of the grain, let us see how much there is left to represent what has been obtained for the skim-milk. The increase in live weight of the pigs brought $65.67, and they ate $35.25 worth of grain. There was left $30.42 as the value received for the skim-milk they ate, which amounted during the experiment to 11,860 pounds. This would be equivalent to about **26 cents per 100 pounds** for the skim-milk.

FERTILIZING VALUE OF FEED.

Though this part of the subject has been often mentioned in previous reports, its importance is too great to allow its being omitted here.

COMPOSITION OF FEED IN POUNDS PEER TON.

	Nitrogen.	Phosphoric Acid.	Potash.	Valuation.
Skim-milk	11.0	4.1	4.2	$2.29
Corn Meal	29.0	12.8	8.0	6.04
Wheat Bran	49.7	60.7	31.3	13.42
Wheat Middlings	47.0	22.1	13.0	9.87
Gluten Meal	99.6	8.5	1.1	17.49

The total fertilizing value of the food eaten is **$31.38** from food that cost **$55.76**, the fertilizing value thus representing **54 per cent** of the market value of the food.

9. THE RELATIVE VALUE OF WHEAT MIDDLINGS AND CORN MEAL AS FOOD FOR YOUNG GROWING PIGS.

By reference to the tables of feed given these pigs it will be noticed that one each of the Large Yorkshires and Small Yorkshires received ¾ lbs. of corn meal daily, and the other received a corresponding amount of wheat middlings. As the rest of their food was the same, whatever difference appears in their growth may fairly be considered as representing the comparative value of these two feeds.

GAIN IN LIVE WEIGHT.

	Grain Feed.	Weight at Beginning of Test. lbs.	Weight at End of Test. lbs.	Weight Gained During Test. lbs.	Total Weight Gained on **Corn Meal.** lbs.	Total Weight Gained on **Middlings.** lbs.
A. Large Yorkshire	Corn Meal	19	206	187		
B. Large Yorkshire	Wheat Middlings	20	194	174		
C. Small Yorkshire	Wheat Middlings	24	180	156		**330**
D. Small Yorkshire	Corn Meal	17	192	175	**362**	

COST OF GROWTH.

	Grain Feed.	Average Daily Gain in Weight. lbs.	Dry Matter Eaten for One Pound Gain in Live Weight. lbs.	Cost of Feed Eaten for Each Pound Increase in Live Weight. cents.	Average Cost of Food Eaten for One Pound of Growth **Corn Meal.** Cents.	Average Cost of Food Eaten for One Pound of Growth **Middlings.** cents.
A. Large Yorkshire	Corn Meal	1.29	2.67	4.01		
B. Large Yorkshire	Middlings	1.20	2.87	4.31		
C. Small Yorkshire	Middlings	1.08	3.20	4.88		
D. Small Yorkshire	Corn Meal	1.26	2.83	4.23	**4.12**	**4.59**

In both cases the results have been decidedly in favor of the corn meal as compared with the wheat middlings, the difference amount to a half a cent a pound in the cost of the pork produced from the two feedings or a difference of **11 per cent** in favor of the corn meal.

QUALITY OF PORK.

Before leaving this subject, it will be well to notice the quality of the pork produced by the system of feeding outlined. The demands of the market for pork have changed in the last few years. Buyers used to seek the hog with the most fat and the least lean, such an animal as would be produced by taking a full grown hog that had been poorly wintered, and feeding it heavily with corn meal, making an animal that would dress 350 to 450 lbs., mostly bone and fat.

The market now desires a smaller animal dressing from 175 to 250 lbs., and containing a mixture of fat and lean through the whole body. To produce such an animal economically, it must be grown quickly and fed from the start with foods that will supply in abundance all the necessities for building up bone, muscle, blood and fat. Skim-milk and bran are admirably adapted to supply the first three elements, and corn meal is undoubtedly the best single food for forming fat. A mixture of these makes the pig both grow and fatten at the same time and produce a pork of superior quality. It is fine grained, firm and sweet flavored. The market recognizes this superiority and is willing to pay extra for it. Were we able to raise a large amount of such pork, we could sell it for a cent and a half a pound above the market price.

SHRINKAGE.

The fact is noteworthy that these pigs shrank much less than is common in dressing. The average of the six pigs is less than **17 per cent** shrinkage, while Burlington butchers say they seldom find a pig that shrinks less than 20 per cent.

10. RICE MEAL *vs.* CORN MEAL.

Rice meal came into our markets a few months ago, and the Station was desired to test its feeding value as compared with the other common feeds. Corn meal was selected as the one best adapted to serve as a basis of comparison. Rice meal is a refuse product from the hulling and cleaning of rice. It is sold at about the same price as wheat bran, and in looks resembles a mixture of light colored corn meal and wheat bran. The following table shows the comparative chemical composition of rice meal and corn meal.

	Water.	Albumenoids.	Fat.	Nitrogen-Free Extract Matter.	Crude Fiber.	Ash.	Phosphoric Acid.	Potash.	Co-efficient of Digestibility of Albumenoids.
Rice meal....	8.04	13.25	13.89	49.84	6.83	8.15	1.87	1.62	79
Corn meal....	15.58	9.13	3.85	68.12	1.89	1.43	0.64	0.40	81
Wheat bran..	12.52	15.02	3.53	53.94	9.31	5.68	3.03	1.56	78

COMPOSITION OF THE ASH.

	Phosphoric Acic.	Potash.	Silica, Lime, etc.
Rice meal................	22.94	19.88	57.18
Corn meal...............	44.75	27.97	27.28
Wheat bran............	53.35	27.47	19.18

So far as chemical analysis is concerned the rice meal seems to hold an intermediate position between corn meal and wheat bran. It has a large amount of ash, but this ash consists so largely of silica from the husks that its value for building up the bones is not so large as in the wheat bran. though greater than that of corn meal. In the albumenoids or muscle-producing part it stands again intermediate, while in the heat-producing parts the fat and the nitrogen-free extract matter, it is inferior to both. Its distinguishing quality is its large amount of fat, containing as it does more than three times as much of this as either corn meal or bran, and which would seem to fit it for a fattening food.

FEEDING TRIALS.

Four pigs were selected for the feeding tests. They were from the same litter of mixed breed, had previously been fed the same, and were nearly equal in weight. Numbers 1 and 2 were fed rice meal mixed with one-half its weight of wheat bran, numbers 3 and 4 received corn meal mixed in the same way with bran. All the pigs received 6 quarts apiece a day of butter-milk.

DAILY FEED.

No. of Pig.	Weight at Beginning of Test. lbs.	Rice Meal. lbs.	Corn Meal. lbs.	Wheat Bran. lbs.	Butter-milk. qts.
1	143	$2\frac{3}{8}$		$1\frac{1}{8}$	6
2	141	$2\frac{3}{8}$		$1\frac{1}{8}$	6
3	145		$2\frac{3}{8}$	$1\frac{1}{8}$	6
4	139		$2\frac{3}{8}$	$1\frac{1}{8}$	6

GAIN IN LIVE WEIGHT.

	Feed.	Weight at Beginning of Test. lbs.	Weight at End of Test. lbs.	Gain in Weight During Test. lbs.	Gain in Weight on **Rice Meal.** lbs.	Gain in Weight on **Corn Meal.** lbs.	Gain in Favor of **Corn Meal.** lbs.
1	Rice meal	143	204	61			
2	Rice meal	141	195	54	**115**		
3	Corn meal	145	217	72			
4	Corn meal	139	209	70		**142**	**27**

The corn meal therefore produced **27** pounds or **23 per cent** more gain in live weight than the rice meal. It would be difficult to set a retail price on the rice meal since it comes from New York city, and its price would vary according to freight rates; near New York its price would be lower than that of corn meal, while in Vermont there would not be much difference. Using the same price $26.00 a ton for both, $24.00 a ton for bran and 10 cents per 100 pounds for butter-milk, the financial side of the test is as follows:

	Feed.	Gain in Weight During Test. lbs.	Value of Food Eaten.	Value of Food Eaten for Each Pound Gain in Weight. cents.	Selling Price Per Pound of Live Weight. cents.	Profit Per Pound. cents.
1 and 2	**Rice meal**	115	$6.84	5.95	5.00	***0.95**
3 and 4	**Corn meal**	142	6.84	4.82	5.00	**0.16**

* Loss.

The difference in the feeding value of the two meals is sufficient to change the large loss from feeding the rice meal to a slight profit on the corn meal feeding. So far as this test is concerned the rice meals shows a decided inferiority to the corn meal as a food for growing and fattening pigs.

It is an interesting fact that in three cases which have come under the author's notice, when rice meal has been fed to milch cows they have begun to shrink in milk and take on flesh.

REPORT OF BOTANIST.

L. R. JONES.

The study of fungous diseases of plants and of remedies for these diseases has been the principal subject of attention during the past year. A fair start has also been made toward the collection of a herbarium.

The absence of the Botanist during several weeks of the summer, prevented the undertaking of any experiments requiring his personal supervision during this time.*

Special attention will be given to the diseases of plants in the future work also of this department. These diseases are generally caused by parasitic plants or *fungi*, and since little has been said in the preceding reports of the Station, about these fungi, it will be well to state here a few facts as to their general nature and the nature and amount of the injuries caused by them.

The injuries to plants due to insects is comparitively well appreciated, but it is not so generally understood that there is scarcely a plant about us, wild or cultivated, that is not preyed upon and more or less seriously injured by parasitic plants or fungi.

Most botanists themselves have only begun to appreciate the extent of these ravages within a few years. An especial incentive has been given to the study of plant diseases within these few years by the discoveries of various compounds like the Bordeaux Mixture, which can be used to check the development and spread of many of them.

WHAT IS THE NATURE OF A FUNGUS?

It is easy to understand the nature of parasitic animals, *i. e.* animals that live upon or in other animals. Lice, Ticks and Tapeworms are familiar examples.

These parasites, as all know, are just as truly animals as are the cattle, sheep, or other animals upon or within which they live. These parasites have, however, because of their peculiar mode of life, become so changed from ordinary animals that they are no longer able to gain an independent livelihood. Their organs of locomotion are dwarfed, through disuse, and their digestive organs changed to suit the delicate, ready-prepared food which they draw from the veins and tissues of their host.†

* The experiments in spraying potatoes were carried out by Mr. Minott, Horticulturist.

† The animal or plant upon or within which a parasite lives is called the *host* of the parasite.

While the locomotive and digestive organs of these parasitic animals are poorly developed, their reproductive organs are correspondingly more developed than those of ordinary animals. The tape-worm, for example, is capable of producing eggs.

Parasitic plants, or Fungi, occupy about the same place in the vegetable kingdom that these parasitic animals occupy in the animal kingdom. These parasitic plants or fungi grow upon, or even within higher plants, feed upon their juices or tissues, and like the parasitic animals, while their other organs are poorly developed their re-productive organs are marvellously active.

Mushrooms or "toad-stools" and puff-balls are the largest and best known of these fungi. It may be well to note briefly the method of growth and development of one of these, the puff-ball for example, since it will illustrate much about the growth and nature of all fungi.*

The portion of the puff-ball which appears above ground is not the whole of the plant, of course, but merely the fruiting portion. Underneath the ground if we examine carefully, we find minute white threads extending away from the puff-ball in all directions like the roots from the base of a stalk of corn. This system of threads is called the *mycelium* of the puff-ball. This mycelium makes up the whole body of the puff-ball plant except the fruiting portion already mentioned; hence it really corresponds in function to both the roots and the leaves of the higher plants.

After the puff-ball becomes mature, if it be broken open an immense cloud of dusty matter is set free. This is familiar to every child. This dust consists largely of the *spores* of the plants which correspond in function to the seeds of higher plants. These spores are produced in immense numbers and being so small are scattered in all directions by the winds. When one of these spores falls in a warm, moist place, it germinates and thus gives rise to a new growth of mycelium. If there is enough decaying vegetable matter for it to feed upon, this mycelium grows rapidly and soon sends up into the air in its turn, its fruiting branches which ripen into puff-balls as before, and a second crop of spores is produced and scattered abroad.

The general structure of the puff-ball plant, and of fungi in general, is then really simpler than that of the higher plants, consisting of 1st—A *mycelium* of minute white or transparent threads which act as feeders, and 2nd—Fruiting branches sent out from this mycelium upon which *spores* are produced. It is to be remembered that in all fungi these spores are *extremely small* and are *produced in immense numbers*.

In some fungi the mycelium grows on the surface of the substance it feeds upon. In the common bread mold the glistening white threads of

*As said before, fungi always feed upon other plants. Many fungi grow upon living plants but puff-balls feed upon decaying vegetable matter.

the mycelium grows upon the surface of the bread and often forms a thick cottony mass before any of the black spores are produced. It is interesting and very instructive to place a piece of moistened bread under a tumbler and watch the growth of this mycelium and the development of the spores.

The green mold of cheese is a fungus of similar general habits. With many other fungi, the mycelium can live only within the tissues of certain plants. Many of these latter are familiar to every farmer, and are sources of serious loss to him every year. The common smut on corn is simply a great mass of black spores, similar to the spores produced in the puff-ball. But while the mycelium of the puff-ball grows in decaying vegetable matter the mycelium of the corn smut makes its home in the tissues of the corn plant, and draws its nourishment from them. The smuts of oats, barley, and other grains, are likewise the spores of other closely related fungi. The common red rust found so plentifully on the stalks and leaves of oats and other grains, is again the spores of a fungus the mycelium of which grows within the grain plant. The black rust of these grains, which usually appears a little later in the season than the red rust, is another kind of spore produced by the same fungus. These black spores have thicker coats and live through the winter, while the red spores are killed by the frost.

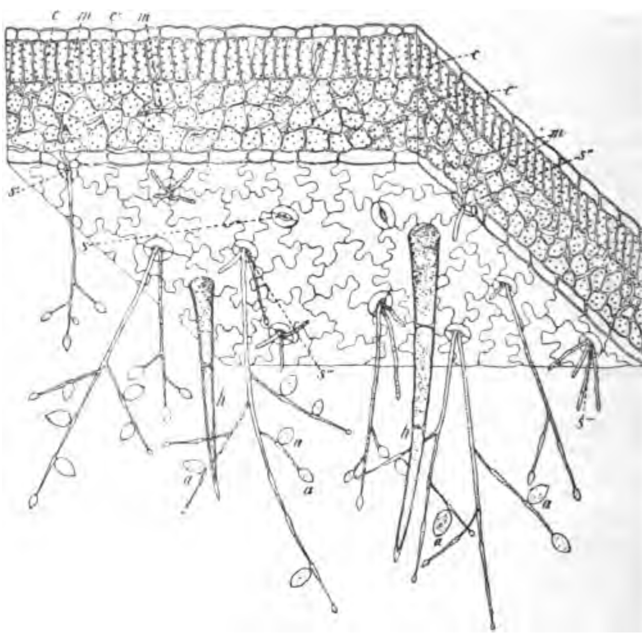
Some common fungous diseases that have been observed during the past year are discussed more fully in the remainder of this report, together with the results of experiments with remedies for them.

POTATO BLIGHT AND ROT.

The *blight* of the tops and the *dry rot* of the tubers are simply different manifestations of one and the same disease. This disease is caused by a parasitic plant or fungus of which the botanical name is *Phytophthora infestans*. We may trace the life-history of the fungus briefly as follows: Examine a tuber affected with dry rot carefully under the microscope and the mycelium of the fungus may be found running through it. The dry rot * is simply the death of the tissues of the tuber from exhaustion as a result of this mycelium feeding upon them. As soon as the tuber dies the mycelium of the fungus dies, but until the tuber is killed the fungus lives and spreads through it. If the tuber is stored in a cool cellar the fungus may not grow fast enough to kill the tissues of the tuber, hence although the mycelium of the fungus is within the tuber, there may be no indications of its presence. Let a tuber affected with dry rot be planted, or even such a tuber as just described, which contains the fungus but does not show any

* The *wet rot* often follows this dry rot, especially if the tubers are in a damp place. This wet rot is the ordinary decay of dead vegetables. It follows the dry rot because the fungus of the dry rot has killed the tissues of the tuber. If the tuber is killed by frost or any other agency the wet rot follows in the same way.

signs of its presence—and many such are planted in Vermont every year. As the potato sprout grows, the mycelium of the fungus grows and penetrates stem, branches and leaves of the potato plant. When the conditions of weather are favorably warm and moist the mycelium sends fruiting branches out through the breathing-pores (stomata) on the underside of the potato leaves, and upon these branches spores are produced in countless profusion. These spore-bearing branches and spores form the whitish patches which look like frost on the underside of the blighting leaves.



The above figure represents, considerably magnified, a small square piece cut from such a potato leaf.

The letters at the upper side of the figure, c, m, c^1, m, c, c^1, m, s^{11}, indicate the cut edges of the piece of leaf. On the under side of the leaf are shown, at h, h, two of the hairs which are so abundant on the under sides of all potato leaves. The slenderer branching stems between are the fruiting branches of the fungus, bearing numerous spores, at a, a, etc. It will be seen that the body of the leaf is made up of cells rather globular in shape (c^1, c^1). These are very important cells to the plant, since in them all the starch of the plant is made. Between these cells in many places the thread-like mycelium of the fungus can be traced, as at m, m, m. It will be evident how this mycelium pushing thus between the cells can draw its food from

them. The lower surface of the leaf is seen to be covered with a single layer of thin protective cells. These are somewhat like pavement slabs or bricks, except that the edges are dovetailed together instead of being straight. Through this layer of cells there are various openings at *s*, s^{1}, s^{11}, s^{111}, s^{1111}, etc. These are the breathing-pores or stomata. The pore or stoma at *s*, and another a little further to the right, are shown in their natural healthy condition, but through all the others (at s^{1}, s^{11}, s^{111}, s^{1111}, etc.), the branches of the fungus are growing. At s^{1} and s^{11}, two of the pores or stomata are cut across, showing how the fruiting branches of the fungus grow out from the mycelium which is within the leaf. At s^{11} and s^{1111} the fruiting branches are just starting; at s^{1} one is seen a little more developed, with four young egg-shaped spores forming on it; at s^{111} and some other of the stomata older, fully developed branches are seen with full grown spores at *a*, *a*, *a*, *a*, *a*, and other points.

The mycelium of the fungus makes an especial drain on the tissues of the plant for food at the time of ripening its spores, and soon kills the leaf at the spot where the spores are produced. These black spots on the leaves in July and August are a familiar sight to every potato grower in the State. They are an indication that the blight is present and ready to spread rapidly if the weather favors the rapid production and germination of the spores. The spores from a single affected plant are enough to carry the blight to a whole potato field in a short time. Striking proof that the blight does spread in this way from a single plant or a few plants is often seen. In the Experiment Station potato field, in 1889, the blight broke out first in one corner and spread diagonally accross the field, *following the direction of the wind.**

It is plain now that if any mixture is sprayed upon the potato leaves which will kill the spores the spread of the blight will be checked. It has been demonstrated by repeated trials during the last few years that the mixture of copper sulphate (blue vitriol or blue-stone) and lime, known as the *Bordeaux Mixture* is a very effective remedy when used in this way.

The Bordeaux Mixture consists of four pounds of copper sulphate (blue vitriol), six pounds of freshly slacked lime and twenty-two gallons of water. Full directions for making and applying this Mixture have been published in Bulletin No. 24.

The value of Bordeaux Mixture as a remedy for the blight and rot was evident in our trial of it in 1889.† Experiments were undertaken last year to determine the relative effect of one, two, and four applications. The regular experimental plots of the Horticulturist, described in his present report, contained over 200 varieties of potatoes. These were all sprayed four times—July 8th, July 18th, August 1st, and August 18th. In all

* See Newspaper Bul. No. 2, and Bul. No. 24, p. 21.

† See Newspaper Bulletin No. 2, and Annual Report, '89, p. 117.

cases Paris Green was added to the Mixture for the potato beetle. The amount of rot in each variety is given in the Horticulturist's report. Fifty of the more commonly known varieties are selected for comparison in the table on page 136. The average amount of rot in these fifty varieties is 5.3%.

An adjoining plot was sprayed so as to test the effects of fewer applications. One end, (the south end), was sprayed once, August 18th, just before the blight appeared; the other end of the same plot, (the north end), was sprayed twice, August 18th and September 16th; the middle of the plot was not sprayed at all.†

The effects of the sprayings were very marked. The potato plants not sprayed blighted badly, and within two weeks were all dead. The ones sprayed blighted some but remained comparatively green until killed by the frost.

Those sprayed twice looked somewhat better than those sprayed once, although the difference in the appearance of the vines was not very marked.

The potatoes were all dug October 11th. One row of each variety was saved apart for examination, the tubers from each end and from the middle being kept by themselves. November 22d these were carefully examined, sorted and weighed. The results are given in detail on page 135.

Taking the averages of each end these results may be summarized as follows:

	Total yield per acre of marketable size.	Proportion of these affected by rot Nov. 22.	Total yield of sound marketable tubers.	Total loss from blight and rot, considering 183 bushels as the full yield.
	Bushels.	Bushels.	Bushels.	Bushels.
North end sprayed twice	183	17¾ (9.7%)	165¼	17¾ (9.7%)
South end sprayed once	173¼	18¼ (10.5%)	155	28 (15.3%)
Middle not sprayed....	136¾	50¾ (37.3%)	86	97 (53.0%)

†For more detailed description of the plot see Bulletin No. 26 pages 22-4.

Variety.	North End, Sprayed Twice.						Middle. Untreated.						South End, Sprayed Once.					
	Number of Hills Saved.	Weight of Tubers of Marketable size from same.	Rotting Tubers Among These.		Corresponding Yield Per Acre.	Corresponding Amount of Rot Per Acre.	Number of Hills Saved.	Weight of Tubers of Marketable Size from same.	Rotting Tubers Among These.		Corresponding Yield Per Acre.	Corresponding Amount of Rot Per Acre.	No of Hills Saved.	Weight of Tubers of Marketable Size from same.	Rotting Tubers Among These.		Corresponding Yield Per Acre.	Correrponding Amount of Rot Per Acre.
		lbs.	lbs.	%	bu.	bu.		lbs.	lbs.	%	bu.	bu.		lbs.	lbs.	%	bu.	bu.
Houlton Hebron							20	$7\frac{3}{4}$	$3\frac{1}{4}$	42	$93\frac{3}{4}$	$39\frac{1}{8}$	18	$12\frac{5}{16}$	$\frac{5}{10}$	$2\frac{6}{10}$	$160\frac{1}{2}$	$4\frac{1}{8}$
Rural N. Y. No. 2	26	$18\frac{1}{2}$	$1\frac{9}{16}$	$7\frac{8}{10}$	172	$14\frac{1}{2}$	40	$21\frac{1}{2}$	8	37	130	$48\frac{1}{2}$						
Early Mayflower	50	$30\frac{3}{8}$	$4\frac{3}{8}$	$14\frac{4}{10}$	147	$21\frac{1}{5}$	60	$33\frac{1}{2}$	23	$68\frac{7}{10}$	135	$92\frac{3}{4}$	20	14	5	$34\frac{8}{10}$	174	$60\frac{3}{4}$
Early King	50	$46\frac{3}{4}$	6	$12\frac{8}{10}$	$226\frac{1}{8}$	29	60	42	23	$34\frac{7}{10}$	$169\frac{1}{2}$	$92\frac{3}{4}$	38	$30\frac{1}{2}$	4	$13\frac{1}{10}$	194	$25\frac{1}{4}$
Ben. Harrison	18	$16\frac{1}{4}$	$1\frac{1}{4}$	$7\frac{7}{10}$	218	$16\frac{4}{5}$	60	$41\frac{1}{4}$	16	$38\frac{8}{10}$	$166\frac{1}{2}$	$64\frac{1}{2}$						
Snow Queen	40	$31\frac{1}{2}$	4	13	$190\frac{1}{2}$	$24\frac{3}{4}$	60	32	17	53	129	$68\frac{1}{2}$	42	$30\frac{1}{4}$	$3\frac{1}{4}$	$10\frac{7}{10}$	$174\frac{1}{5}$	$18\frac{3}{4}$
Hampden Beauty	20	$10\frac{3}{4}$	$1\frac{3}{4}$	$16\frac{3}{10}$	130	$21\frac{1}{5}$	56	$32\frac{1}{2}$	10	$30\frac{8}{10}$	$140\frac{1}{2}$	$43\frac{1}{4}$						
Beauty of Hebron	18	$9\frac{1}{2}$	0		$127\frac{7}{10}$	0	60	30	5	$16\frac{7}{10}$	121	$20\frac{1}{5}$	20	$15\frac{1}{4}$	$1\frac{1}{4}$	$8\frac{8}{10}$	$184\frac{1}{2}$	15
Burbank's Sport							44	$24\frac{3}{4}$	$2\frac{1}{4}$	9	136	$12\frac{1}{8}$	24	22	0	0	222	0
White Star							40	24	$4\frac{1}{8}$	$17\frac{3}{10}$	145	25	24	$16\frac{1}{2}$	0	0	$166\frac{4}{10}$	0

LIABILITY OF DIFFERENT VARIETIES OF POTATO TO ROT.

This is a question of considerable interest and of practical importance. There is no doubt that certain varieties of potatoes are much more susceptible to rot than others. Late varieties rot much worse than early ones, and certain of the late varieties rot worse than others. Certain of the varieties below had no rotten tubers. This should not be taken as an indication that these varities are "rot-proof," however. The amount of rot may depend so much upon other things than variety—*e. g.*, soil, drainage, depth of tubers, possibilities of infection at time of digging, etc.—that the results of a single year should be taken as suggestive rather than conclusive. The Horticulturist has kindly furnished a list of fifty of the better known varieties of potatoes which were grown at the Experiment Farm last year together with the per cent of rot in them. This list is given below. These were all grown on clay soil and sprayed four times with Bordeaux Mixture and Paris Green. The potatoes were dug and stored in October, and examinations for rot were made the latter part of December.

Variety.	Per Cent of Rotten Tubers.	Variety.	Per Cent of Rotten Tubers.
1 Advance	1.57	24 Hampden's Beauty	16.66
2 Alexander's Prolific	3.60	25 Home Comfort	5.26
3 Beauty of Hebron	7.84	26 Junkis	2.79
4 Ben Harrison	4.17	27 Late Beauty of Hebron	6.22
5 Bliss' Triumph	0.00	28 Lee's Fovorite	12.04
6 Boston Market	2.18	29 Monroe Co. Prize	9.42
7 Brownell's Best	1.28	30 New Rose	1.46
8 " No. 55	0.74	31 Northern Queen	3.39
9 " Superior	1.18	32 Pecan	8.60
10 " Winner	4.67	33 Polaris	3.72
11 Burbank's Seedling	0.00	34 Putnam's Beauty	11.19
12 Burpee's Superior	5.04	35 " New Rose	18.62
13 Chas. Downing	1.43	36 Rural Blush	3.55
14 Clark's No. 1	6.25	37 Rural N. Y. No. 2	0.00
15 Dictator	0.99	38 Seneca Red Jacket	8.43
16 Early Essex	15.92	39 Snowflake	1.54
17 " Green Mt.	0.77	40 Stray Beauty	9.73
18 " King	9.23	41 Thorburn	1.60
19 " Mayflower	2.69	42 Vermont Champion	3.31
20 " Oxford	18.88	43 White Beauty of Hebron	1.00
21 " Rose	1.88	44 " Elephant	11.56
22 " Washington	2.37	45 " Star	2.88
23 Extra Early Vermont	5.08		

Mr. C. C. Haynes of Wilmington, Vt., conducted a test of varieties under the direction of the Horticulturist. Mr. Haynes tested twenty-four varieties; the soil was very uniform, a clay loam; planted June 9th, dug Sept. 14th. The tubers were then well dried and placed on shelves until March 1st, 1891. when, at our request, Mr. Haynes made a careful examination of them * and reported as follows:

Variety.	Per Cent of Rotten Tubers.		Variety.	Per Cent of Rotten Tubers.	
	Large	Small		Large	Small
1 Burbank's Sport	13	29	13 Nathan Rose	65	70
2 Chicago Sun	24	50	14 N. Y. Plush	9	—
3 Daisy	6	31	15 Orange Co. White	17	23
4 Danby	24	46	16 Parker & Wood	23	29
5 Early Gem	54	57	17 Putnam's Beauty	52	39
6 " Goodrich	48	32	18 Randall's Beauty	14	
7 " King	57	55	19 Rose's New Giant	29	50
8 " Rose	51	—	20 B'rpee's S'dl'g, No. 37	23	47
9 Garrison's No. 8	13	21	21 Victory	50	20
10 Houlton Hebron	40	—	22 White Bermuda	66	48
11 Irish Champion	52	36	23 " Flower	15	15
12 Magnum Bonum	2		24 " Seedling	25	40

DISINFECTION OF SEED POTATOES.

Since the only way that the fungus of potato rot (*Phytophthora infestans*) is known to live through the winter is in the tubers which contain the mycelium, it would obviously be a great boon if seed potatoes could be treated in some way so as to kill this mycelium whenever present without injuring the value of the tubers for seed.

Two methods of treatment have been proposed. First, to soak the tubers in a solution of copper sulphate. Second, to heat them.

An attempt was made last summer to determine the value of these treatments. Tubers badly affected with dry rot were selected. Each tuber was cut in two lengthwise, so as to give each half an equal number of promising eyes, and one half of each was treated and the other half untreated as follows:

* In Mr. Haynes' report the sound and rotten tubers were counted, in our own examinations they were weighed. His results show therefore the relative numbers of rotten, ours show the relative weights of rotten.

First Set. Soaked 24 hours in solution of copper sulphate. (One part of copper sulphate to one hundred and five of water.)*

Second Set. Untreated halves of first.

Third Set. † Heated six hours in sealed jars immersed in water at temperature 106°-108° F.

Fourth Set. Untreated halves of third.

Some from each set were planted in each of four green-houses, and the remainder in the opposite corners of a forty-acre field, and at least sixty rods from any other potato field. Not one of those soaked in the copper sulphate solution grew.

Of the other three sets all grew. The ones in the green houses were drawn up to spindling stems and did not at any time appear healthy. The plants of the second and third sets died about August fifteenth, and of the fourth set about September fifteenth. The ones planted in the field grew with no differences that could not be attributed to differences in soil. Some leaves on all three plots showed black spots from the first of August until they were killed by the frost, but no fruiting fungus was found upon any of them. The tubers were dug the first of October and stored in the regular potato cellar. When examined March 13th they were all apparently sound. The soil was a pretty stiff clay. The probable explanation of the fact that blight did not appear more noticeably, is that the plants were in single rows and not very close together in the row, nor very leafy, hence there was little chance for that retention of moisture so necessary to the development of the fungus.

The experiment showed pretty conclusively that the copper sulphate solution can not be used of that strength and for that length of time, and seems to indicate that it probably cannot be used at all. The results as to the value of heating the tubers show that the heating did not noticeably injure the germinating power of the tuber. As to its disinfecting effects we do not feel justified in drawing conclusions..

SMUT ON OATS.

By actual count it was found that the smutted oat plants in the various fields and experimental plots in 1890 ranged from a fraction of one per cent up to *twenty-three per cent*, and that the average in all plots was about *ten per cent*. From this and similar examinations made at other stations, we think that *the average loss from oat smut throughout the State reaches nearly ten per cent of the total crop each year.*

*F. L. Scribner in Tennessee, Bul. Vol. II, No. 2, says: "It is said that tubers may be disinfected by soaking twenty-four in a solution of sulphate of copper, four to six ounces of sulphate in water enough to cover a bushel of potatoes." We weighed this amount of water and found that it was about forty pounds, (630 ounces). Six ounces sulphate in 630 ounces water, equals 1:105.

†Heating the tubers for the purpose of disinfecting them was first recommended we believe by Mr. Jensen of Copenhagen, several years ago.

In Bulletin No. 9 several remedies for oat smut were recommended.* It has been proved that these will prevent most if not all of the smut, but we have reason to fear that some of them, notably the copper sulphate solution, will injure the value of the oats for seed.

We wish that those farmers of the State, especially interested in oat raising, would examine their oat fields more carefully than usual this summer and try to satisfy themselves as to the amount of their loss from this disease,† meanwhile the Station will test the efficacy of certain proposed remedies and report upon them later.

A NEW (?) OAT DISEASE.

According to reports from various sections of the State, the young oat plants suffered seriously during the spring and early summer of 1890 from "rust." These reports stated that it was the common "red rust" of oats. No specimens were sent to the Station.

Later observations and reports lead us to believe that the disease was not the common rust which is caused by the fungus *Puccinia graminis*, but due to some other cause, possibly to the very different fungus, *Fusicladium destruens*, described by C. H. Peck, N. Y. State Botanist, as observed for the first time last year in St. Lawrence county, N. Y.‡

APPLE RUST AND CEDER APPLES.

Mr. John E. Smith of South Burlington, reported to the Station that his apple orchard suffered seriously in 1889, and in previous years, from some rust which caused the leaves to fall during the summer. His apple crop had been seriously injured for several years by this rust. Upon visiting his orchard we found that a number of red cedar trees were growing in and about the place. The branches of these red cedar trees were covered with "cedar apples." Here was the explanation of the trouble. These cedar apples are a fungous growth and strange as it seems, the same fungi which cause these "cedar apples" also attack the apple leaves and cause the "rust" on them.§

* These were:
First. Soak seed 40 hours in solution of 1 pound of copper sulphate in 4 gallons water.
Second. Soak seed 24 hours in solution of 1 pound caustic potash in 6 gallons water.
Third. Soak seed 24 hours in solution castile soap in water with enough quick lime added to color the liquid milky white.
Fourth. Soak several hours in brine strong enough to float an egg.

† The easiest and most satisfactory way to do this is to cut all the plants from a small area, say a few square feet, then sort out the smutted plants carefully and count healthy and smutted.
To get a fair idea of a field it is generally necessary to examine several such samples from different portions of the field.

‡ See 43d Report of N. Y. Museum of Nat. History, page 76.

§ A description of the fungus with plates showing the appearance of rusted apple leaves and of the "cedar apples," will be found in the Report of Department of Agriculture for 1888, p. 378, and accompanying plates XI and XII.

Since the spores from the "cedar apples" cause the rust on the apple leaves, the quickest and surest remedy is manifestly to grub out and burn the red cedars. Mr. Smith consented, however, to an experiment to test the effects of spraying the apple trees with ammoniacal copper carbonate.*

On May 17th one of the apple trees was sprayed thoroughly. The limbs of this tree mingled on one side with those of an infected red cedar, and the apple tree had been the worst rusted of any in the orchard in 1889. At the time of spraying, the apple leaves were about half size and the flower buds swollen. Only a few of the cedar apples had sent out their characteristic jelly-like protrusions. A week later the tree was examined and it was found that some injury to foliage had been caused by the solution, many leaves being spotted. On May 30th this tree was again sprayed, the solution being diluted by adding one-half more water than before. Another tree was also sprayed.

July 2d the leaves were examined on a typical branch of the first tree sprayed and of another adjacent tree which had not been treated. The results were:

Healthy leaves on tree sprayed	215	25%
Rusted " " " "	645	75%
Total	860	100%
Healthy leaves on tree not sprayed	450	23%
Rusted " " " " "	1541	77%
	1991	100%

This shows no marked difference in the number of affected leaves, although the real benefit of the spraying in this respect was greater than the above figures indicate because the sprayed tree had been in previous years attacked considerably the worse of the two. The rust was not so abundant on the individual leaves of the sprayed tree, although about as many leaves were attacked on the sprayed tree as on the unsprayed.

The benefits of the spraying did show very decidedly in the general appearance of the trees. This was still more evident in August. The leaves of the unsprayed tree had then nearly all fallen and the remaining leaves were small and badly rusted, while the apples were few, small and of no value.

The sprayed tree was far from healthy looking but it had kept most of its leaves and was ripening a fair crop of fruit. No good apples were gotten from the unsprayed tree; from the sprayed about two barrels were gotten. The tree sprayed May 30th was helped some but not nearly so much.

* One ounce copper carbonate dissolved in one quart ammonia then diluted with water to twenty-five gallons.

ONION SMUT.

In 1889 serious trouble from "smut" and "blight" was reported by onion-growers about Burlington, and more especially from Grand Isle. This disease was doubtless due to a fungus, but as no botanist was then connected with the Experiment Station and as no specimens or exact information as to the nature of the disease have been procurable since our connection with the Station, we cannot say with certainty which of the several fungus enemies of the onion caused the disease. It was planned to study this disease and its possible remedies last summer, but only a small per cent of the seed sown in our experimental plot germinated. As no reports of smut were received from onion growers, we conclude that little or no loss was experienced in 1890 from the disease.

We hope that onion growers who are troubled will let us know promptly upon any serious outbreak of the disease this summer, and send us specimens of the diseased plants, that we may learn more about the disease and help to control it if possible.

BLACK KNOT OF PLUM AND CHERRY.

Black knot is prevalent and troublesome about Burlington on both plum and cherry trees, and reports have come to us from various parts of the State of its general prevalence. Indeed it seems to have practically exterminated these trees in many orchards of the State. The disease is too well known to require description. It does not seem to be generally appreciated, however, that black knot is caused by a fungus, and that from the knots of one tree, millions of spores are annually discharged to infect other trees in the same or adjoining orchards. When this fact is appreciated the remedy will scarcely need to be emphasized. *Cut down and burn every badly affected tree and thoroughly prune out the affected limbs of those not so badly attacked, AND SEE THAT YOUR NEIGHBORS DO THE SAME.*

As the fungus flourishes on most species of wild plums and cherries it will be necessary to watch these trees as well as the cultivated ones.

It is evident that by united action a fungus which is so conspicuous and so slow in its development as this can soon be controlled, or even exterminated, if a united fight is made against it. To assist in and insure such work we need a State law operating against these contagious diseases of plants just as we now have laws operating against similar contagious diseases of animals. It is believed that a law which will have this end in view can be framed and presented to the next legislature, and if so, it ought to have, and we trust will have, the earnest support of every farmer and fruit grower of the State.

NOTES UPON SOME OTHER FUNGOUS DISEASES WHICH ARE PREVALENT.

BLACK SCAB OF APPLE.—This is caused by the fungus *Fusicladium dendriticum.* The spores are produced in olive green patches upon the fruit and leaves, and even upon the younger branches of the trees. We found a luxurious growth of the fungus producing myriads of spores upon Greenings several weeks after they were stored in our cellar last fall. It is possible that conditions may be such that these spores may germinate and spread the disease to the uninfected fruit after storing. If so, this may explain in part the spotting of the apples after they are barrelled.

Experiments at the Wisconsin and Michigan Stations in 1889 showed that by proper spraying much of the injury from the scab fungus can be prevented.

Mr. Goff of the Wisconsin Station, recommends as the results of his experiments the following treatment: "Dissolve one ounce of copper carbonate in one quart ammonia (strength of 22° Baume). Keep corked tightly until ready for use, then dilute with 25 gallons of water. Spray once just before the flowers open, a second time just after the petals fall and repeat at intervals of two or three weeks until midsummer. Wait a few hours after spraying with this before spraying with Paris green for the codling moth."

BLACK SCAB OF PEAR. This is especially troublesome on Flemish Beauty Pears. It is caused by a fungus growth, in the same way that apple scab is, and can doubtless be checked in the same way.

PEAR BLIGHT, *Fire B light,* occurs everywhere about the State, and needs no description from us. It is caused by the action of bacteria (*Micrococcus amylovorus*). The only remedy known is to cut off the smaller limbs a foot or two below the lowest manifestation of the disease, and to shave out the spots where the disease appears on the trunk, cutting deeply enough to remove all discolored tissue. A good precaution is to disinfect the knife after cutting through a diseased spot by dipping in carbolic acid.

The same blight attacks apple trees, though not so commonly as it does the pear. An outbreak of what was probably apple blight was reported to us from the southern part of the State. The same treatment is recommended as for pear blight.

STRAWBERRY LEAF-BLIGHT.—The spotting of strawberry leaves is another disease familiar to every one. The disease appears on the leaves as small reddish or purplish spots, which increase in size and change in color, until finally they are from one-sixth to one-third of an inch in diameter, and have a grayish white center, surrounded by a purple border which shades off into a reddish brown at the outer edges.

Remedy.—The disease causes most injury by attacking the new growth of plants which spring up first after the berries have ripened. This injury can be much lessened by in some way destroying the old infected leaves as soon as the berries are picked. This can be readily done by mowing the leaves close to the ground, and burning them as soon as they have dried enough. Another way of accomplishing the same object recommended in the Report of the Department of Agriculture for 1889 is to spray the plants with a solution consisting of one pint of sulphuric acid to six gallons of water. For the ordinary gardener the method of burning will be found preferable, however.

Several other fungus diseases occurred about Burlington to a serious extent last summer, which were harder to control. Among these was *Clover Rust,* occurring as small brownish red spots on the leaves of clover. It is caused by the fungus *Uromyces Trifolii.* In one field examined in October it was hard to find a leaf that was not attacked by this fungus. It is difficult to estimate just how great was the damage from this rust, but it is certainly a serious disease and may well be watched.

The *Currant Rust* or *Leaf Spot Disease,* caused by the fungus *Septoria Ribis* was very injurious upon the currant bushes at the Experiment Farm last summer. It shows as whitish spots with dark centers through the middle and latter part of the summer. The leaves began to fall early and the bushes were nearly naked by the middle of September.

The *Cane Rust* was very injurious to Black and Red Raspberries and to Blackberries. This is a disease which has been observed but little until the last few years, but which threatens to be very injurious. It is caused by the fungus *Gleosporium necator.* The disease appears first on the young canes as small purplish spots. These enlarge and the centers change to a dirty white. On the older canes the spots often merge together and nearly cover the surface of the canes. The disease appears similarly on all parts of the leaves.

Ergot was very abundant on rye. This is caused by the fungus *Claviceps purpurea.* It forms the conspicuous black "spurs" on the head which are often three-quarters of an inch in length. A small field of spring wheat near the Station was also badly ergoted. The spurs on the wheat were smaller and thicker, differing in shape from the spurs on the rye, in about the same way that the kernels of the two grains differ.

It was found very abundantly on various species of native grasses also.

The loss of grain or grass from ergot is usually comparatively slight, but where it occurs very abundantly it is injurious to the stock eating it, often causing abortion.

The grape mildews, the Downy mildew caused by the fungus *Peronospera viticola,* and the Powdery mildew caused by *Uncinula spiralis* wer

both observed at various points about the State, and did considerable damage in some cases reported to us. As most grape growers know, these diseases can be controlled by the use of the Bordeaux Mixture as recommended for the potato rot. If any one wishes further information concerning these diseases or their remedies we shall be glad to answer any letters of inquiry.

The Powdery Mildew of the cherry caused by the fungus *Podosphaera oxycantheae* was found doing some damage upon a few young cherry trees. It was observed too late in the season to check it, as could doubtless have been done by spraying earlier.

Hollyhock Rust caused by the fungus *Puccinia Malvacearum* was found in several places in and about Burlington. This disease appears as small wart-like swellings on the lower side of the leaves of hollyhocks, and when these become numerous the leaf may die.

These swellings vary in color from a grayish-brown to a dark-brown. In size they vary from a small dot to the size of a pin-head or larger.

This fungus is of a peculiar interest, since it was introduced into this country only a comparatively few years ago from South America, and is gradually spreading.

We collected last summer plants showing specimens of the diseases spoken of in this report. We shall be glad to distribute these as long as our supply lasts to persons in the State who are interested in these diseases and who will write for them, stating what ones they wish.

We are grateful for information concerning any unusual occurrence of any plant disease. Always send specimens of the diseased plants when you can. Any letters of inquiry concerning plant diseases or remedies for the same will be promptly answered.

REPORT OF THE HORTICULTURIST.

By C. W. MINOTT.

The principal work in this department during the past season may be outlined as follows:

I. Comparative tests with vegetables.

II. Comparative tests with small fruits.

III. Test with Bordeaux Mixture in connection with Paris green on potatoes.

VEGETABLE TESTS.

Comparative tests were undertaken with the most common varieties of vegetables; all were planted side by side and received the same treatment throughout the season.

Eight hundred pounds of a complete fertilizer were used per acre on the land occupied by the vegetables—applied broadcast and harrowed in, and rows were then marked out and planted without any other application of fertilizing material.

TESTS OF VEGETABLES.

Explanation of Abbreviations.—The following abbreviations are used for the names of Seedsmen, in order to economize space:

Alex	O. H. Alexander	Charlotte, Vt.
Aln	C. E. Allen	Brattleboro, Vt.
B. & W	Burrill & Whitman	Little Falls, N. Y.
Bragg	B. L. Bragg & Co	Springfield, Mass.
Bpee	W. Atlee Burpee & Co	Philadelphia, Pa.
Buist	Robert Buist, Jr	Philadelphia, Pa.
Breck	Joseph Breck & Sons	Boston, Mass.
Bar	F. Barteldes & Co	Lawrence, Kan.
Bdg	Alfred Bridgeman	New York, N. Y.
Bouk	James W. Bouk	Greenwood, Neb.
Bush	D. I. Bushnell & Co	St. Louis. Mo.
C. Bro	Currie Bros	Milwaukee, Wis.
Childs	John Lewis Childs	Queens, N. Y.
Clev	A. B. Cleveland & Co	New York, N. Y.
Corn	W. H. Cornish & Co	Newburgh, N. Y.
Dreer	Henry Dreer	Philadelphia, Pa.
Ding	Dingee & Conard Co	West Grove, Pa.
Evtt	J. A. Everitt & Co	Indianapolis, Ind.
Ely	Z. DeForest Ely & Co	Philadelphia, Pa.
Ferry	D. M. Ferry & Co	Detroit, Mich.
Fax	M. B. Faxon	Boston, Mass.
Farn	P. J. Farnsworth	Fairfax, Vt.
Faust	H. G. Faust & Co	Philadelphia, Pa.
Farq	R. & J. Farquhar	Boston, Mass.
Greg	J. J. H. Gregory	Marblehead, Mass.
G. & R	Giddings & Read	Rutland, Vt.
Hen	Peter Henderson & Co	New York, N. Y.
Hill	H. H. Hill	Isle La Motte, Vt.
Hov	Hovey & Co	Boston, Mass.
Hors	F. H. Horsford	Charlotte, Vt.
Howe	G. D. Howe	North Hadley, Mass.
Hosk	Dr. T. H. Hoskins, Memphremagog Seed Farm	Newport, Vt.
Hal	V. H. Hallock, Son & Thorpe	Queens, N. Y.
Har	Joseph Harris Seed Co	Rochester, N. Y.
Hicks	D. C. Hicks	North Clarendon, Vt.
Higg	Higganum Man'f'g Co	New York, N. Y.
I. S. Co	Iowa Seed Co	Des Moines, Ia.
Jer	G. W. P. Jerrard	Caribou, Me.
J. & S	Johnson & Stokes	Philadelphia, Pa.
Liv	A. W. Livingston's Sons	Columbus, Ohio.
Low	Aaron Low	Essex, Mass.
Land	David Landreth & Sons	Philadelphia, Pa.
Leon	S. F. Leonard	Chicago, Ill.
Mle	William Henry Maule	Philadelphia, Pa.
M. & A	Moorehouse & Annis	Rochester, N. Y.
Me	Maine Experiment Station	Orono, Me.
Minn	Minnesota " "	St. Anthony Park, Minn.
Mich	Michigan " "	Agricultural College, Mich.
Md	Maryland " "	College Park, Md.
N. Y	N. Y. State " "	Geneva, N Y.
Nel	A. C. Nellis & Co	New York, N. Y.
Nott	Richard Nott	Burlington, Vt.
N. B. & G	Northrup, Braslan & Goodwin Co	Minneapolis, Minn.
P. & W	Parker & Wood	Boston, Mass.
Perry	A. D. Perry & Co	Syracuse, N. Y.
Peirce	A. G. Peirce	Burlington, Vt.
Platt	Theron E. Platt	Newton, Conn,
Price & R	Price & Reed	Albany, N. Y.
Raw	W. W. Rawson	Boston, Mass.
Salz	John A. Salzer	LaCrosse, Wis.
Sch. & F	Schlegel & Fotler	Boston, Mass.
Sim	J. A. Simmers	Toronto, Ont.
Sib	Hiram Sibley & Co	Rochester, N. Y.
S. & H	Storrs & Harrison	Painesville, Ohio.
Sta	Vermont Experiment Station	Burlington, Vt.
Suf	J. C. Suffern	Voorhies, Ill.
Thor	J. M. Thorburn & Co	New York, N. Y.
Till	I. F. Tillinghast	La Plume, Pa.
U. S	U. S. Dep't of Agriculture	Washington, D. C.
Vick	James Vick	Rochester, N. Y.
Vau	J. C. Vaughan	Chicago, Ill.
Wil	Samuel Wilson	Mechanicsville, Pa.

BUSH BEANS.

Thirty-one varieties of Bush Beans were planted June 18 in rows three feet apart and one foot in the row.

The Golden-podded Wax still holds the lead, and is the best yellow-podded string variety all things considered.

Henderson's New Bush Lima seems desirable, promising an improvement on the pole varieties, but like them must be planted early in the season for satisfactory results.

The following tabulations give the most important data collected :

Garden No.	NAME.	Seed from.	When planted.	First vegetation.	First blossom.	First edible maturity, string.	Days from planting.	First edible maturity, shell.	Days from planting.	Ripe maturity.	Days from planting.	Average No. pods per vine.	Average No. beans per pod.	Average height of vine.
			June.	June.	July.	Aug.		Aug.		Sept.				in.
2305	Black Wax	Alex	18	25	23	3	46	20	63	10	84	8.	3.62	11
2303	Boston Favorite	Low	18	26	30	8	51	29	72	18	92	7.	2.90	12
2309	Carmine Pd'd Dw'f Hort.	Sta.	18	27	24	4	47	18	61	12	86	4.60	3.95	9
5523	China Red Eye	Ferry	18	26	24	4	47	20	63	6	80	5.60	3.87	10
2314	Detroit Wax	Ferry	18	27	25	4	47	20	63	12	86	5.40	4.03	10
5524	Dolly Varden	Bouk	18	26	24	3	46	18	61	6	80	6.20	3.79	10
2320	Dwarf Cranberry	Farns	18	26	23	4	47	18	61	12	86	7.30	3.69	11
2318	Dwarf Golden Wax	Sta.	18	26	20	1	44	17	60	Aug. 29	72	6.30	3.66	9
2313	Dwarf Prolific	Childs	18	26	31	10	53	Sept. 4	78	Sept. 22	96	21.60	3.75	11
5525	Ely's Dwarf Wax	Ely	18	26	23	3	46	Aug. 18	61	6	80	9.	3.41	9
2371	Eureka Pole or Bush	Farns	18	27	31	10	53	29	72	18	92	12.8	3.08	11
2324	First of All	Mle	18	26	24	4	47	20	63	5	79	11.70	2.71	7
5526	Giant Wax	Corn	18	26	24	3	46	18	61	6	80	7.80	3.65	11
2325	Golden Eyed Wax	Low	18	26	25	4	47	18	61	6	80	8.70	3.54	12
2327	Golden Pod Yellow Eyed Wax	Raw	18	25	25	4	47	18	61	4	78	6.60	3.59	12

Garden No.	NAME.	Seed from.	When planted.	First vegetation.	First blossom.	First edible maturity, string.	Days from planting.	First edible maturity, shell.	Days from planting.	Ripe maturity.	Days from planting.	Average No pods per vine.	Average No. beans per pod.	Average height of vine.
			June.	June.	July.	Aug.		Aug.		Sept.				in.
5527	Imp. Golden Wax	Raw	18	26	24	4	47	18	61	5	79	7.60	3.34	10
2328	Imp. Hort. Bush	Breck	18	26	26	9	52	29	72	18	92	10.40	3.07	13
2329	Imp. Hort. Bush	Low	18	26	24	9	52	25	68	17	91	8.80	3.21	13
5528	Imp. Six Weeks	Liv	18	25	23	3	46	18	61	12	86	8.10	3.51	11
2337	M'b'l'h'd Dwarf Hort	Sta	18	26	23	4	47	18	61	6	80	7.7	3.71	14
2330	Kumerle's Dwarf Lima	Thor	18	27	Aug. 18									
2339	New Bush Lima	Hen	18	26	3	Sept. 6	80	Sept. 18	92	Sept. 25	99	10.1	2.64	8
5529	New Bush Lima	Bpee		No	germi	nation								
5530	Orange Co. White	Corn	18	24	July. 22	Aug. 3	46	Aug. 18	61	Aug. 29	72			
2341	Pink Eye Wax Golden Pod	Land	18	25	23	3	46	18	61	Sept. 4	78	9.	4.17	8
2348	Red Kidney	Sta	18	25	24	6	49	20	63	16	90	6.7	2.88	14
2347	Red Valentine	Sta	18	26	25	4	47	18	61	12	86	19.5	3.74	11
2346	Rose	Salz	18	26	27	6	49	Sept. 4	78	18	92	15.5	2.96	13
5532	Ruby Dwarf Hort	Raw	18	27	30	9	52	Aug. 28	71	14	88	11.6	3.33	11
5533	Saddle Back Wax	Bpee	18	25	23	3	46	18	61	4	78	9.9	3.63	12
2355	Warren Bush	Sta	18	26	26	5	48	19	62	14	88	7.2	4.	11
2353	Wax Date	Sta	18	26	24	3	46	18	61	4	78	7.3	4.	12
2360	Yosemite	Hen	18	26	26	5	48	24	67	14	88	6.8	2.45	10

FIELD BEANS.

Ten varieties of bush beans most commonly grown in this section for market, were planted by themselves; they received the same treatment as the other varieties in all particulars. Aroostook proved the earliest, but the Improved Field set the larger number of pods, and, judging from this season's test, seems a desirable variety.

Garden No.	Name.	Seed from.	Time planted.	First vegetation.	First blossom.	First edible maturity string.	Days from planting.	First edible maturity shell.	Days from planting.	Ripe maturity.	Days from planting.	Av. No. pods per vine.	Av. No. beans per pod.	Av. height of vine. In.
5522	Boston Small Pea	Vick	June 18	June 23	July 27	Aug. 6	49	Aug. 24	67	Sept. 10	84	13.80	4.14	14
2304	Burlingame Medium	Mle.	18	23	24	4	47	18	61	4	78	9.	3.80	13
2307	Canadian Wonder	N. B. & G.	18	26	27	6	49	Sept. 4	78	20	94	9.80	2.88	13
2323	Early Aroostook	Sta.	18	25	23	4	47	Aug. 21	64	6	80	11.10	3.38	10
5531	Improved Field	N. B. & G.	18	23	29	6	49	20	63	20	94	24.	3.93	14
2342	Prolific D'wf Tree	Sim.	18	24	Aug. 5	24	67	Sept. 10	84	22	96	18.30	3.74	15
2345	Rice	Sta.	18	24	1	16	59	4	78	18	92	13.60	4.32	12
2350	Snowflake	Greg.	18	24	July 26	5	48	Aug. 24	67	4	78	12.40	4.01	12
2351	Tree	Hill	18	24	31	8	51	Sept. 11	85	22	96	16.20	3.91	14
2357	White Wonderfield	Salz.	18	24	26	5	48	Aug. 21	64	12	86	12.60	4.47	13

POLE BEANS.

Six varieties of Pole Beans were planted June 18, in rows three feet apart and one foot in the row.

Carmine Wax proved the earliest, but as grown here the past three years it has not been as prolific as Brocton Pole, although the pods are more showy consequently will sell better in market.

Garden No.	NAME.	Seed from.	When planted.	First vegetation.	First blossom.	First edible maturity string.	Days from planting.	First edible maturity shell.	Days from planting.	Ripe maturity.	Days from planting.
2364	Brockton Pole	Low	June 18	June 27	July 31	Aug. 13	56	Sept. 10	84	Sept. 25	99
2366	Carmine Wax	Sta.	18	26	31	6	49	Aug. 25	68	14	88
2370	Early Golden Cluster	Low	18	26	31	13	56	Sept. 12	86		
2380	P. & W. Defiance	T.&W	18	29	Aug. 4	13	56	6	80		
5536	Sunshine Wax	Bpee	18	26	9	25	68	11	85		
2385	White Wax	S.&F.	18	26	1	10	53	30	73		

BEETS.

On the twenty-first of June seventeen varieties of Beets were sown in drills, sixteen inches apart, and fifteen feet long; afterwards thinned so that they stood about six inches apart in the row.

None proved better than Bastian's. Henderson's Pine Apple does not seem to be well established, as roots of all shapes were taken from the row.

Garden No.	Name.	Seed from.	When sown.	First vegetation.	First edible size.	Days from planting.	No. of marketable roots.	Weight of same.		No. of marketable roots.	Weight of same.	
			Jun.	Jun	Aug			lbs.	oz.		lbs.	oz.
2388	Arlington	Raw	21	27	9	49	10	4	3	11	3	9
2389	Bastian's Turnip	"	21	25	9	49	18	17	9	10	2	11
2390	Crosby's Imp. Egyptian	"	21	26	7	47	10	3	9	10	2	1
2393	Early B'ld Red Turnip	Land	21	26	9	49	12	5	9	5	1	10
2392	Early Crimson	Faust	21	27	9	49	15	7	6	6	1	3
2395	Early Jewell	G&R	21	26	13	53	11	5	15	9	1	4
2394	Early Othello	Buist	21	27	16	56	10	4	5	7	1	3
2391	Edmund's E'y B'ld T'nip	Low	21	27	13	53	14	5	3	8	1	8
2397	Fifty Day	Ev'tt	21	26	9	49	15	7	0	3		15
2398	Land. Early Forcing	Land	21	27	9	49	8	3	8	6	1	9
2399	Lentz	G&R	21	25	9	49	19	9	0	5	1	2
5544	Market Gardeners	I.S.Co	21	26	13	53	4	2	8	14	2	9
5545	Mitchell's Perfected	Hen.	21	26	13	53	18	6	5	6		14
2400	Phila. Early Turnip	Mle.	21	26	9	49	15	7	2	6	1	14
5546	Pine Apple	Hen.	21	27	29	69	7	3	6	10	1	2
2401	Red Beauty	Salz.	21	27	11	51	14	7	1			
5547	Trial (Sample N.)	Bpee.	21	25	20	60	14	10	10	3		9

CARROTS.

On the twenty-first of June, sixteen varieties of carrots were sown in drills sixteen inches apart, fifteen feet long, afterwards thinned to about six inches in the row.

The Danvers proved the most satisfactory.

Garden No.	Name.	Seed from.	When sown.	First vegetation.	No. of marketable roots.	Weight of same.		No. unmarketable roots.	Weight of same.	
			June.	June.		lbs.	oz.		lbs.	oz.
2406 A	Danvers	Low.	21	27	21	7	10			
2407	" Half Long	Fax.	"	27	24	10	10			
5548	Early " " Red.	Hen.	"	30	20	3	10	7		5
2408	H'f L'g ScarletCarrent'n	Sib.	"	30	11	3	2	6		9
5549	Improved Long Orange.	Mle.	"	28	11	2	12	16	1	8
2409	Intermediate Red	Hen.	"	30	8	1	14	15		14
5550	Nantes 3rd Early	Land.	"	30	15	2	13	6		5
5551	New Half Long	"	"	28	15	2	12	16	1	2
2411	Norman Belgian	Salz.	"	29	20	5	1			
2412 A	Orthe	Sim'rs	"	28	10	4	4	10	1	9
2413	Oxheart (or Guerande)	G.&R.	"	29	12	3	6	15	1	7
5552	Rubicon Half Long	Higg.	"	29	15	4	0	10		13
2414	St. Valery	Leon.	"	29	13	3	10	18	1	15
2415	True Danvers	P. & W.	"	30	8	3	0	8		15
2416	Vt. Butter	Hosk.	"	29	10	2	0	12	1	4
5553	Yellow Imperial	N.B.&G	"	July. 2	10	2	10	3		2

DENT CORN.

Thirty-four varieties of Dent Corn were planted on the second day of June, in rows three feet apart and three feet in the row; three stalks only were allowed to grow in each hill.

Thorough cultivation was given and all varieties received the same treatment; none of the varieties gave as good results as were obtained in 1889.

The most important data collected are given in the following tabulations.

Garden No.	NAME.	Seed from.	When planted.	First vegetation.	First tassel.	First silk.	First edible maturity.	Days from planting.	Glazed.	Days from planting.	Average no. ears per stalk.	Av. height of stalks.	Average wt. of hill. (3 stalks.)	Tons per acre of 5,000 hills.
			June.	June.	Aug.	Aug.	Sept.					ft. in.		
2456	Arleus	Wil.	2	11	5	14	14	104			$1\frac{1}{2}$	6—6	6— 0.8	$15\frac{1}{8}$
2458	Big Buckeye	Liv.	2	11	11	22					1	7—6	6— 1.6	$15\frac{1}{4}$
2459	Boston Market	Breck.	2	13	17	24					2	8	7— 8	$18\frac{3}{4}$
2460	Briar Crest Beauty	Mle.	2	11	20	24					$1\frac{1}{2}$	8	7— 8.8	$18\frac{7}{8}$
2461	B. & W	B. & W.	2	11	31	Sept. 3					1	9	7— 0.8	$17\frac{5}{8}$
2462	Capital	Evtt.	2	11	11	Aug. 18					1	8—6	6— 3.2	$15\frac{1}{2}$
2476 A	Champion Pearl	Suff.	2	11	6	15					1	7—6	6— 2.4	$15\frac{3}{8}$
2463	Chester County Mammoth	Bpee.	2	11	14	27					1	8	5—10.2	$14\frac{15}{16}$
2464	Dakota Dent	N B & G	2	11	3	6	4	94	14	104	1	7	4— 8	$11\frac{1}{4}$
2470	Early Mastodon	Mle.	2	12	9	18	13	103			1	8	6— 4	$15\frac{5}{8}$
2469	Early Prolific	Wil.	2	11	7	12					1	8	6— 9.6	$16\frac{1}{2}$
2466	Earliest White Dent	Salz.	2	11	3	10	6	96			$1\frac{1}{2}$	6—6	5— 6	$13\frac{7}{16}$
2473	Edmunds' Premium Dent	Leon.	2	11	3	10	14	104			1	7—6	5	$12\frac{1}{2}$

DENT CORN.—*Continued.*

Garden No.	NAME.	Seed from.	When planted.	First vegetation.	First tassel.	First silk.	First edible maturity.	Days from planting.	Glazed.	Days from planting.	Average No. ears per stalk.	Av. height of stalks.	Average wt. of hill. (3 stalks.)	Tons per acre of 5,000 hills.
			June.	June.	Aug.	Aug.	Sept.					ft. in.		
2471	Evans	Bush.	2	11	11	27					1	8	6—12.8	17
2475	Golden Beauty	N.B.&G	2	13	20	27					1	8	4—12.4	11 7/16
2477	Hickory King	Salz.	2	11	17	26					1	8	6— 8	16 1/4
2482	Leaming	Wil.	2	11	10	18	16	106			1	7—6	5— 1.2	12 11/16
2486	Minnesota King	N.B.&G	2	11	3	5	4	94	14	104	1	6	4— 8	11 1/4
2485	North Star	Leon.	2	11	3	7	3	93	14	104	1	6	4— 2.8	10 7/16
2490	Parish White Dent	Vaughn	2	12	12	27					1	9	5—12	14 3/8
2491	Perfect Mammoth	P. & W.	2	11	9	25					1	8	5— 8	13 3/4
2489	Prairie Queen	Bush.	2	11	7	16					1	7—6	6— 8	16 1/4
2488	Pride of the North	N.B.&G	2	11	1	6	1	91	10	100	1	6	3—15.2	9 7/8
2493	Queen	Bush.	2	11	18	22					1	8	6—12	16 7/8
2492	Queen of the North	Salz.	2	11	2	4	6	96	16	106	1	6	3—12	9 3/8
2496	Red Cob	Bush.	2	11	13	24					1	8	5—10.8	14 3/16
5506	Russels	Bgg.	2	11	2	4	5	95	14	104	1	6	3— 6.4	8 1/2
2494	Rustler	N.B.&G	2	11	2	9	10	100			1	6—6	4—12.4	11 15/16
2498	Salzers 125	Salz.	2	12	3	16	16	106			1	7—6	5—10.2	14 1/8
2497	Sheep Tooth	N.B.&G	2	11	16	28					1	7	5— 2.4	12 7/8
2507	Virginia Horsetooth	Thor.	2	11	Sept. 2	Sept. 5					1	8	6— 2.4	15 3/8
2510	Wardsworth Yellow Dent	Vaughn	2	11	Aug. 4	Aug. 10	14	104			1	5—6	3— 5.2	8 5/16
2509	White Giant of Normandy	U. S.	2	11	10	21					1	7—6	4— 2	10 5/16
2508	Wis. Yellow Dent	Vaughn	2	11	8	12	5	95	14	104	1	6	3—14.8	9 13/16

FLINT CORN.

Twenty-six varieties of Flint corn were planted on June 2 in hills 3x3 feet; only three stalks were allowed to grow in a hill; the treatment was the same throughout the season for all varieties.

The following tabulations give the data collected:

Garden No.	Name.	Seed from.	When planted.	First vegetation.	First tassel.	First silk.	First edible maturity	Days from planting.	Glazed.	Days from planting.	Average No. Ears to a stalk.	Average height of stalks.	Average weight of hill (3 stalks.)	Tons per acre of 5,000 hills.
												ft. in.	lb. oz.	
2455	American Prolific	Alex	June 2	June. 11	July. 24	Aug. 4	Aug. 30	89	Sept. 12	102	1	4—6	3— 8.8	8⅞
2454	Angel of Midnight	N. B. & G.	2	11	31	9	Sept. 1	91	14	104	1	5—6	4	10
2457	Canada 12-rowed	Allen	2	11	31	8	3	93	10	100	1	5	4	10
5500	Early Bryant	Jerr	2	11	19	July. 26	Aug. 15	74	Aug. 29	88	1	2—6		
2468	Early Columbia	Allen	2	11	25	Aug. 4	27	86	Sept. 6	96	1	5	3—11.2	9¼
2467	Early Demond	Bgg	2	11	29	6	Sept. 3	93	11	101	2	5—6	4— 9.6	11½
2472	Early Golden Harvest	P. & W.	2	11	31	7	12	102			1	4—6	3—12.4	9 7/16
2465	Early Summer	Land	2	11	29	6	6	96	12	102	1	5	3—10.4	9⅛
2476	Giddings	G. & R.	2	11	19	1	Aug. 18	77	Aug. 30	89	1	4—3		
2474	Golden Dewdrop	Nott	2	11	23	3	20	79	Sept. 3	93	1	5	2— 9.6	6½
5501	Holden	Allen	2	11	22	2	24	83	6	96	1½	5	3—12.8	9½
2478	Hudson Bay	Sibley	2	11	30	4	25	84	6	96	1½	5	2—14.4	7¼

FLINT CORN.—*Continued.*

Garden No.	Name.	Seed from.	When planted.	First vegetation.	First tassel.	First silk.	First edible maturity.	Days from planting.	Glazed.	Days from planting.	Av. No. ears to a stalk.	Average height of stalks.	Average weight hill (3 stalks.)	Tons per acre of 5,000 hills.
												ft. in.	lb. oz.	
5502	Improved 8-Rowed	Harris	June. 2	June. 11	July. 27	Aug. 4	Sept. 6	96	Sept. 12	102	1½	5—6	3—15.2	9⅞
2481	Kingsbury	King	2	11	20	July. 31	Aug. 19	78	Aug. 29	88	1	4	2—12.8	7
2480	King Philip	Hen	2	11	Aug. 1	Aug. 8	Sept. 4	94	Sept. 14	104	1½	5—6	5— 4	13⅛
2483	Longfellow	Thor	2	11	July. 27	8	8	98			1	5—6	5—13.6	14⅝
2484	Mercer or Rideout	Cur. Bros	2	11	29	5	4	94	14	104	1½	5	3—11.2	9¼
5503	Milliken's Prize	Breck	2	11	29	9	10	100			1½	6	5— 9.6	14
5504	Orange Co. White	Cornish	2	11	Aug. 1	10	6	96			1	6	5—14.4	14¾
2500	Sanford	Pierce	2	11	July. 31	7	6	96			1	5	3— 14	9 11/16
2500 A	Sanford	Sta.	2	11	30	6	6	96			2	5	4— 4	10⅝
2500 B	Sanford		2	11	31	9	9	99			2	6—6	5—14.4	14¾
2499	Self-Husking	Bgg	2	11	25	4	4	94	14	104	1½	5	4— 1.6	10¼
2501	Smut Nose	Vaughn	2	11	22	2	Aug. 22	81	4	94	1	4—6	3— 6.4	8½
2502	Thoroughbred White Flint-	Thor	2	11	Aug. 7	20	Sept. 19	109			1½	6—6	8— 7.2	21⅛
2505	Vt. Eureka	Nott	2	11	July. 22	4	Ang. 29	88	8	98	1½	4	4	10
2504	Vt. Pedigree	Alex	2	11	24	4	28	87	6	96	1	5—6	3—10.4	9⅛
5505	Waushakum	Breck	2	11	31	6	Sept. 3	93	16	106	2	5—6	6	15

SWEET CORN.

Forty-seven varieties of Sweet Corn were planted on June 2, in hills 3x3 feet, three stalks only were allowed to grow in each hill. Three varieties that proved as early as the Cory last season have maintained their position. The following tabulations give the most important data collected :

Garden No.	Name.	Seed from.	When planted.	First vegetation.	First tassel.	First silk.	First edible maturity.	Days from planting.	Av. height of stalks.	Height of first ear from ground.	Av. No. ears per stalk.
2513	Acme	Evtt.	June 2	June 12	Aug. 3	Aug. 16	Sept. 6	96	5 ft. 6 in.	1 ft. 7 in.	2
2512	Albany	Dreer.	2	11	July 28	6	Aug. 30	89	5 3	12	1½
2514	Alexander Sugar	Alex.	2	12	Aug. 4	11	Sept. 10	100	5 6	12	2
2507	Alexander No. 4, Red Kernel	"	2	12	July 22	July 31	Aug. 17	76	4 3	5	1
2507 A	Alexander No. 4, White Kernel	"	2	11	20	31	15	74	3 9	4	1
5508	Best of All	Bouk.	2	11	Aug. 3	Aug. 9	Sept. 3	93	5 6	10	2
2516	Burbank's Early Maine	Vaughn	2	12	July 19	July 31	Aug. 16	75	3 4	3	1½
2519	Chicago Market (or Ballard)	Leon.	2	12	22	Aug. 2	20	79	4 5	4	1½
2521	Colossal	Cleve.	2	11	Aug. 3	12	Sept. 11	101	5 10	1 1	2
2517	Conqueror	Vau.	2	11	July 28	6	4	94	4 10	7	1
2518 A	Cory	Jerr.	2	12	18	July 28	Aug. 14	73	5 4	3	1
2520	Creedmoor	Hal.	2	12	Aug. 4	Aug. 16	Sept. 16	106	5 9	1 5	1½
2522	Durkee	Greg.	2	13	July 24	6	2	92	4 4	5	2
2525	Early Bonanza	Wil.	2	13	Aug. 2	15	7	97	4	12	1
2528	Early Dean	Hosk.	2	11	July 19	July 29	Aug. 15	74	3	4	1
2524	Early Lacrosse	Salz.	2	13	19	30	15	74	3 9	4	2
2529	Early Mexican Sweet	Hosk.	2	13	22	30	17	76	3	4	1½
5510	Early White Cory	Allen.	2	11	19	30	15	74	3 6	6	1
5509	Electric	Fill.	2	13	19	29	15	74	2 6	5	1½
5530	Egyptian	U. S.	2	12	Aug. 6	Aug. 20	Sept. 16	106	5	1 3	2
2527	Everbearing	Mle.	2	13	July 31	7	7	97	4	1 3	1
2531	Farq's First Crop	Farq.	2	13	22	July 31	Aug. 15	74	3 6	5	1

SWEET CORN.—*Continued.*

Garden No.	Name.	Seed from.	When planted.	First vegetation.	First tassel.	First silk.	First edible maturity.	Days from planting.	Av. height of stalks.		Height of first ear from ground.		Av. No. ears per stalk.
									ft.	in.	ft.	in.	
5511	First of All	Dreer.	June 2	June 12	July 19	July 29	Aug. 14	73	3			5	1
5512	Guarantee	J. & S.	2	11	Aug. 5	Aug. 13	Sept. 12	102	3	6		12	1⅓
2534	Hicox's Improved	Harris.	2	11	6	16	14	104	4	6	1	1	1½
2533	Honey	S. & H.	2	12	5	10	6	96	4		1	3	1⅛
2535	Improved Evergreen	U. S.	2	12	5	15	11	101	4	6	1	6	2
2538	Maule's XX Sugar	Mle.	2	13	2	10	6	96	3	6		12	2
5521	Macomber	Mac.	3	12	July 21	July 31	Aug. 17	75	3	4		5	1
2542	New Queen	Evtt.	2	13	19	30	15	74	2	9		4	2
2540	No. 48	Salz.	2	11	19	28	14	73	3			5	1
2541	Northern Pedigree	"	2	13	22	Aug. 1	18	77	2	6		3	2
2545	Perry's Hybrid	Nott.	2	12	24	5	24	83	4			8	2
5513	P. & K.	"	2	12	31	9	Sept. 6	96	3	6		10	2
2546	Potter's Excelsior	Fax.	2	16	Aug. 5	15	12	102	4	6		12	2
2547	Premier	Breck.	2	13	4	13	10	100	4			10	2
2548	Pride of America	Alex.	2	13	July 22	July 29	Aug. 14	73	3			4	1
2549	Rose's Improved Evergreen	G. & R.	2	12	29	Aug. 8	Sept. 3	93	4			8	2
5514	Roslyn's Hybrid	Hen.	2	12	Aug. 3	15	14	104	4	6	1	2	2
5516	Shaker's Early	Allen.	2	11	Jvly 28	5	5	95	4			6	2
5518	Shoe Peg	Breck.	2	13	Aug. 10	20	16	106	4	6		12	2
5515	Simpsonia Prolific	Wil.	2	12	9	24	19	109	5		1	6	1½
5517	Squaw	N.B.&G	2	11	July 18	July 29	Aug. 19	78	3			3	2
2551	Stabler's Early	Nott.	2	13	31	Aug. 9	Sept. 5	95	3	6		5	2
5519	Stabler's Nonpareil	Dreer.	2	12	Aug. 3	16	16	106	4	6	1	3	2
2552	True Crosby	P. & W.	2	12	July 22	3	Aug. 20	79	4			6	2
5520	White Squaw	Hosk.	2	11	18	July 26	18	77	3			4	1⅓

CUCUMBERS.

Thirteen varieties of Cucumbers were planted on the 20th of June, in hills 5x6 feet, five hills of each variety. Nearly all the vines were affected with a rust which injured them so badly that nothing like a crop was produced.

Astro produced fruit 18 to 20 inches long, of good shape and color.

The data obtained is given in the following table:

Garden No.	NAME.	Seed from	When planted.	First vegetation.	First bloom.	First pickling size.	Days from planting.	First marketable size.	Days from planting.	No. marketable picked from 3 hills previous to Aug. 29.	No. unmarketable picked from 3 hills previous to Aug. 29.	
5563	Astro	I. S. Co.	June. 20	June. 24	July. 29	Aug. 6	47	Aug. 12	53			
2431	Boston Pickling	Land.	20	25	29	5	46	11	52	34	1	
2435	Early Cluster	Greg.	20	25	29	11	52	15	56	19		
2433	Extra Early	Mle.	20	25	27	6	47	12	53	32	7	
2436	Giant Pera	Bpee.	20	25	30	8	49	13	54	11		
5559	Green Mountain	Alex.	20	25	27	6	47	12	53	23	17	
2438	Improved White Spine	Greg.	20	25	31	10	51	16	57	19		Ex. fine.
2441	Nichols Medium Green	"	20	25	29	6	47	13	54	15	3	
2442	Perfection	Salz.	20	25	Aug. 2	13	54	20	61	13		
5560	Perfect White Spine	I. S. Co.	20	25	3	12	53	18	59	10		
2445	Siberian	N. B. & G.	20	25	July 28	5	46	10	51			
2450	War Club	N. B. & G.	20	25	Aug. 1	10	51	16	57			
2452	Westerfields Pickle		20	25	1	8	49	13	54	10	1	

EARLY PEAS.

Thirty-four varieties of Early Peas were planted for trial test on June 18, in drills 15 feet long, rows three feet apart. With the exception of a few varieties there was but little difference in the time of edible maturity between the so-called early and medium.

The division is made from the catalogue description, and in a few cases were we to revise the list it would be well to change varieties to their proper place.

The following data give the most important notes taken during the season:

Garden No.	NAME.	Seed from	When sown.	First vegetation.	First blossom.	First edible maturity.	Days from planting.	Ripe maturity.	Days from planting.	No. pods 10 vines.	Average No.	No. peas in pods.	Av. No. per pod.
			June	June	July	July		Aug.					
2665	Am Wonder	Sta.	18	25	15	29	41	24	67				
2666	Breck's Gem	Land.	18	24	14	28	40	14	57	39	3.9	158	4.
2668	Challenge, Ex. Early	Cur. Bro.	18	25	14	27	39	12	55	34	3.4	121	3.5
5537	Chelsea	Hen.	18	25	15	30	42	24	67	44	4.4	206	4.7
5539	Dreer's Ex. Early Pioneer	Dreer.	18	24	14	27	39	10	53	33	3.3	111	3.3
2669	Dwarf, R. N. Y.	Alex.	18	25	14	26	38	9	52	28	2.8	106	3.7
2670	Early May	Salz.	18	26	15	31	43	26	69	27	2.7	76	2.8
2671	Earliest and Best	Salz.	18	24	14	27	39	11	54	37	3.7	127	3.4
2672	Early Prize	G. & R.	18	24	15	29	41	16	59	32	3.2	115	3.5
2674	Early Morning Star	Buist.	18	25	14	27	39	9	52	23	2.3	72	3.1
2675	Earliest of All	Mle.	18	26	15	27	39	13	56	27	2.7	100	3.7
5540	Electric	Till.	18	24	14	26	38	14	57	33	3.3	118	3.5
2673	Epicure	Hen.	18	26	15	31	43	21	64	37	3.7	134	3.6
2676	Eureka, Ex. Early	Dreer.	18	26	14	27	39	11	54	25	2.5	90	3.6
2678	Family Garden	Mle.	18	26	14	28	40	12	55	29	2.9	111	3.8
2679	First and Best of All	Leon.	18	25	15	27	39	20	63	26	2.6	85	3.2
2681	Hampden Earliest	Bgg.	18	26	14	28	40	13	56	29	2.9	96	3.3

EARLY PEAS.—*Continued.*

Garden No.	NAME.	Seed from	When sown.	First vegetation.	First blossom.	First edible maturity.	Days from planting.	Ripe maturity.	Days from planting.	No. pods 10 vines.	Average No.	No. peas in pods.	Av. No. per pod.
2682	Hen. First of All	Hen.	June 18	June 25	July 14	July 27	39	Aug. 13	56	32	3.2	111	3.4
5541	Improved Early Magog	Hosk.	18	26	21	Aug. 5	48	25	68	39	3.9	120	3.
2683	Improved Gem	Allen	18	26	15	July 30	42	18	61	24	2.4	76	3.1
2683 A	Improved Extra Early	Mle.	18	25	13	28	40	15	58	24	2.4	78	3.2
2684	King of the Dwarf	Greg.	18	25	15	30	42	24	67	28	2.8	86	3.
2686	Land. Ex. Early	Land.	18	25	13	25	37	9	52	22	2.2	96	4.3
2685	Liv. First in the Market	Liv.	18	25	14	27	39	9	52	29	2.9	112	3.8
2688	Maud S	Vaug.	18	25	14	27	39	10	53	23	2.3	82	3.5
2687	Mininum	Greg.	18	25	15	30	42	16	59	28	2.8	111	3.9
2690	New Abundance	Mle.	18	26	19	Aug. 5	48	Sep. 6	80	38	3.8	110	2.8
2689	New Cable	Alex.	18	25	15	July 29	41	Aug. 25	68	27	2.7	92	3.4
2691	New Evolution	Mle.	18	25	30	Aug. 15	58	Sep. 20	94	21	2.1	75	3.5
2692	Premier Ex. Early	Buist.	18	25	14	July 26	38	Aug. 9	52	20	2.	69	3.4
5564	Quality	Bpee.	18	26	19	Aug. 1	44	Sep. 6	80	63	6.3	165	2.6
2693	Summit	N. B. & G.	18	26	14	July 25	37	Aug. 9	52	25	2.5	90	3.6
2694	Very Dwf. Early Frame	Land.	18	25	14	27	39	9	52	29	2.9	104	3.5
5542	Vermont Wonder	Hosk.	18	26	15	29	41	18	61	24	2.4	74	3.

MEDIUM PEAS.

Garden No.	NAME.	Seed from	When sown.	Frist vegetation.	First bloom.	First edible maturity.	Days from planting.	Ripe maturity.	Days from planting.	No. pods on 10 vines.	Av. No. per vine.	No. peas in pods.	Av. No. per pod.
2695	Bergen Fleetwing	Greg.	June 18	June 25	July 14	July 27	39	Aug. 9	52	27	2.7	106	3.9
2696	Blue Beauty	Hen.	18	24	15	30	42	17	60	38	3.8	137	3.6
5554	Burpee's Profusion	Bpee.	21	29	27	Aug. 13	53	Sept. 14	85	43	4.3	120	2.8
2698	Carter's Anticipation	Allen	18	26	25	9	52	14	88	46	4.6	166	3.6
2697	" Lightning	"	18	25	13	July 2	39	Aug. 9	52	25	2.4	94	3.8
5538	Childs' Universal	Childs	18	26	15	31	43	20	63	36	3.6	103	2.9
2699	Cleveland's Alaska	Bgg.	18	26	13	26	38	13	56	35	3.5	121	3.5
2701	Dan O'Rourke	Greg.	18	26	14	27	39	10	53	22	2.2	68	3.9
2700	Delicious	"	18	27	27	Aug. 11	54	Sept. 18	92	41	4.1	112	2.7
2703	Dew Drop	G. & R.	18	27	16	1	44	Aug. 24	67	32	3.2	116	3.6
2704	Excelsior	Allen	18	26	14	July 27	39	10	53	31	3.1	114	3.6
2703 A	Ex. Early Vt	Nott	18	26	14	27	39	10	53	28	2.8	123	4.4
2706	First and Best	Sib.	18	26	13	26	38	9	52	27	2.7	98	3.6
2705	Free Trade	Hors.	18	25	14	27	39	10	53	23	2.3	100	4.3
2708	Hancock	Greg.	18	25	14	27	39	9	52	27	2.7	96	3.6
2711	Market Garden	Hors.	18	26	24	Aug. 7	50	Sept. 12	86	33	3.3	141	4.3
2710	Midsummer	Hen.	18	27	26	11	54	12	86	47	4.7	164	3.5
2712	Nott's No. 7	Nott	18	26	15	July 30	42	Aug. 18	61	24	2.4	79	3.3
2714	Pride of Lamoille	Farns.	18	27	15	29	41	24	67	24	2.4	72	3.0
2713	" " the Market	Leon	18	26	22	Aug. 9	52	Sept. 14	88	24	2.4	105	4.4
2715	Quantity	Bpee.	18	26	24	6	49	6	80	49	4.9	166	3.4
2717	Read's Favorite	G. & R.	18	26	26	11	54	14	88	39	3.9	195	5.0
2719	Summer's First of All	Sim.	18	24	15	July 31	43	Aug. 21	64				
5543	Sutton's Satisfaction	J. & S.	18	25	25	Aug. 9	52	Sept. 6	80	47	4.7	130	2.8
2720	Telegraph	Sim.	18	25	23	6	49	12	86				

POTATOES.

The tubers used for seed in the comparative trials this season, were all grown at the Station, the previous season, under similar conditions ; all housed in the same cellar, and treated alike throughout in all particulars.

During cold weather, from the 1st of December to the 1st of May, the average temperature of the storage cellar was about 38° F.; from the 1st of May to the 26th, the average temperature was about 45°.

On May 26th we commenced to cut tubers for seed, and in all cases where possible two-eye pieces were used ; the limited number of tubers in some cases necessitated the using of small whole tubers, or pieces cut to one eye.

On May 30, all varieties were planted in rows three feet apart and one foot in the rows, covered about two inches deep. In the after cultivation the furrows were filled up, and on the 16th of July a double mould board plow was run between the rows, ridging them up somewhat.

October 3rd and 4th, all varieties were dug and placed in cellar. January 1st, all varieties were looked over, record made of decayed tubers, weight taken of merchantable and unmerchantable, also specific gravity ; from the weights taken at this time, the tubers being dry and free from dirt, the yield per acre was reckoned, calling 14,520 hills a full stand.

Owing to a clayey section across the piece, it seems advisable to divide the varieties, viz.: those grown on the more heavy clay and those on the light clay loam.

The most important data collected are given in the following tabulations:

VARIETIES GROWN ON LIGHT CLAY LOAM.

Garden No.	NAME.	Seed from	Condition of seed when planted.	Tubers, how cut.	First vegetation.	First blossom.	Av. height of vine.		No. merch. tubers.	Weight of same.	No. unmerch. tubers.	Weight of same.	No. decayed tubers.	Weight of same.	Yield yer acre.	Specific gravity.
				Eyes.	June	July	ft.	in.		lbs. oz.		lbs. oz.		lbs. oz.	b's	
2949	Astonisher	Farns.	ext. good	2	17	15	2	0	33	13- 3	3	- 3.2			249	1.079
2950	Adirondack	"	ext. good	2	15	15	1	8	55	13-14.4	28	- 3.2	1	- 3.2	262	1.101
2951	Andrew's White Rose	"	good	2	19		1	3	40	7- 9.6	25	1- 6.4	9	1-14.4	199	1.069
2952	Arctic	"	med.	2	13	10	1	5	46	13-14.4	17	- 8	3	-14.4	284	1.078
2953	Acme	"	good	2	15	13	1	10	48	15- 9	14	-14.4	1	- 4.8	312	
2955	Alaska	Alex.	ext. good	2	13	10	1	10	51	13-14.4	11	- 6.4	9	2- 4.8	307	
2956	American Wonder No. 20	"	med.	2	13	8	1	6	48	10- 1.6	9	-12.8	10	3-14.4	273	1.073
2957	American	N. Y.	med.	2	15	17	1	8	53	11- 9.6	10	-12.8	4	-12.8	243	1.087
2958	Arundel Rose	"	good	2	13	11	1	9	50	11- 9.6	11	1-	11	2- 9.6	281	1.076
2959	Angell Seedling	"	good	2	15	17	1	6	52	9-11.2	15	1- 1.6	14	2-12.8	282	1.059
2960	Austin's Seedling	"	med.	2	15	11	1	6	48	14- 1.6	6	- 8	1	- 3.2	275	1.078
2961	Alexander's Prolific	Putnam		2	13	11	1	5	37	10- 8	7	- 3.2	2	- 6.4	206	1.090
2962	Advance		good	2	15	13	1	6	46	8-14.4	5	- 6.4	5	1-14.4	193	1.088
2964	Blackhawk Standard	Wis.	good	2	11		1	3	34	10- 9.6	15	1- 1.6	5	2- 3.2	277	1.073
2969	Brownell's Superior	Md.	good	2	13	17	1	6	45	10- 3.2	10	1-	6	1- 8	236	1.087
2970	Brownell's No. 55	"	good	2	15	16	1	6	60	12- 4.8	14	1- 3.2	1	- 1.6	251	1.088
2971	Brownell's No. 31	"	good	2	17		1	6	65	13-12.8	22	1-12.8	6	1- 4.8	310	1.086
2972	Burpee's Superior	Hicks	med.	2	16		1	3	54	10- 8	14	-14.4	4	- 9.6	221	1.044
2973	Ben Harrison	G. & R.	ext. good	2	13	11	1	6	50	15- 3.2	10	-14.4	3	-11.2	312	1.087
2974	Blue Elephant	Farns.	bad	2	16	24	2	0	37	6- 1.6	20	1- 1.6	21	3- 9.6	193	1.069
2975	Blue Star	"	med.	2	15	23	1	8	36	9-14.4	3	- 6.4	5	2- 1.6	230	1.060

VARIETIES GROWN ON LIGHT CLAY LOAM.– *Continued.*

Garden No.	NAME.	Seed from	Condition of seed when planted.	Tubers, how cut.	First vegetation.	First blossom.	Av. height of vine.	No. merch. tubers.	Weight of same.	No. unmerch. tubers.	Weight of same.	No. decayed tubers.	Weight of same.	Yield per acre.	Specific gravity.
				Eyes.	June	July	ft. in.		lbs. oz.		lbs. oz.		lbs. oz.	b's	
2976	Belle	Farns.	good	2	16	19	1 7	44	14-12.8	12	-11.2	2	-12.8	303	1.080
2977	Boston Market	Pltt.	med.	2	15	11	1 3	43	8	12	- 9.6	15	2- 6.4	204	1.086
5000	Chatauqua No. 1	Hicks	good	2	15		1 3	46	9- 6.4	29	1- 4.8	3	-11.2	212	1.082
5001	Copper Mine	Mich.	good	2	15		1 4	31	11-11.2	11	- 6.4	4	- 8	236	1.061
5002	Cream of the Field	G. & Read	med.	2	15	11	1 4	30	12- 1.6	6	- 6.4	3	1-	251	1.078
5003	Chicago Market	Farns.	good	2	18	11	1 3	37	8-14.4	16	- 9.6	5	-11.2	189	1.084
5004	Chicago Sun	"	good	2	16		1 4	38	11	11	-14.4	1	- 8	230	1.065
5005	Cherry Blow	Platt	good	2	15	18	1 8	27	6-14.4	3	- 1.6	8	2- 9.6	198	1.022
5006	Champlain	"		2	13	10	1 4	36	8- 1.6	6	- 6.4	9	2-11.2	271	1.044
5007	Centennial	"	med.	2	13	12	1 1	28	4- 3.2	8	- 4.8	13	2- 4.8	182	1.070
5008	Chitticatica	"	good	2	13	12	1 5	14	3- 8	13	- 8	1	- 3.2	145	1.075
5009	Chas. Downing	Alex.	med.	2	16		1 0	21	3-11.2	13	- 8	7	-11.2	169	1.088
5010	Canada Prince Albert	Bgg.	med.	2	13	15	1 0	17	2- 6.4	15	- 6.4	8	-14.4	111	1.074
5011	Corliss' Matchless	True	good	2	17	12	1 5	26	7- 6.4	19	1-	1	- 1.6	228	1.074
5012	Connecticut	Platt	med.	2	15	13	1 8	38	8- 9.6	27	1-12.8	2	- 9.6	221	1.084
5014	Country Pride	Farns.	bad	2	17	18	1 2	25	5- 9.6	16	-11.2	9	1- .6	137	1.069
5015	Charter Oak	Sta.	good	2	13		1 5	26	4- 1.6	23	1- 1.6	2	- 1.6	98	1.071
5016	Clark's No. 1	Greg.	med.	2	13	12	1 3	31	6-14.4	12	- 9.6	2	- 8	148	1.076
5017	Cow Horn	Sta.	good	2	18	30	2 0	38	8- 6.4	9	- 6.4			163	1.087
5018	Daisy	Farns.	good	2	19	31	1 8	42	9- 9-6	25	- 1.8			206	1.069
5019	Duchess	"	good	2	15		1 4	20	5-11.2	11	- 8			115	1.071

VARIETIES GROWN ON LIGHT CLAY LOAM.—*Continued.*

Garden No.	NAME.	Seed from.	Condition of seed when planted.	Tubers how cut.	First vegetation.	First blossom.	Av. height of vine.	No. merch. tubers.	Weight of same.	No. unmerch. tu'rs.	Weight of same.	No. decayed tubers	Weight of same.	Yield per acre.	Specific gravity.
				eyes			ft. in.							bu.	
5020	Dakota Seedling	Minn.	Medium	2	June 19	Aug. 3	10	4	6.4	9	- 6.4			17	1.069
5021	Dandy	Jerr.	Good	2	15		1 6	35	10- 9.6	3	- 4.8			202	1.091
5022	Dakota White	N. Y.	Good	2	13		1 6	38	11- 8	4	- 1.6	2	- 3.2	219	1.086
5023	Dunmore	Maine	Good	2	13		1 8	32	11-14.4	7	4 - .8	4	1- 6.4	274	1.074
5024	Dictator	Sta.	ExGood	2	14		1 6	39	12- 1.6	11	- 9.6	3	1- 6.4	262	1.066
5060	Early Illinois	Md.	Good	2	13	July 10	1 5	38	8- 9.6	6	- 6.4	9	2-14.4	221	1.079
5061	Early French Giant	"	Good	2	18	Aug. 3	1 8	20	9- 6.4	5	- 6.4	1	- 4.8	187	1.088
5063	Early Dawn	"	ExGood	2	13	July 19	1 9	43	12-14.4	12	-12.8	3	.14.4	271	1.087
5064	Early Hovey's Advancer	"	Good	2	15		1 5	23	2-11.2	7	- 4.8	12	2-11.2	106	1.082
5065	Eximas	"	Good	2	13		1 6	42	10	6	- 4.8	11	3- 9.6	258	1.076
5066	Everlasting Yielder	"	Good	2	16		1 6	56	11-12.8	24	1- 4.8	9	-12.8	258	1.072
5067	Early Durham	Farns.	Medium	2	15	11	1 5	32	6- 3.2	10	- 4.8	18	3-	176	1.077
5068	Early Magog	"	Good	2	15	18	1 1	24	3	23	1-	10	-12.8	96	1.101
5069	Early Green Mountain	"	Good	2	15		1 11	49	12- 6.4	16	-12.8	8	1- 1.6	266	1.079
5070	Early Strawberry	"	Good	2	15		1 10	14	2- 1.6	13	- 8	6	- 9.6	90	1.068
5072	Early Market	Vick	Good	2	15		1	24	5	4	- 1.6	8	1- 6.4	121	1.074
5074	Early Montana	Alex.	Medium	2	15	11	1 1	26	3- 1.6	6	- 4.8	16	3-12.8	145	1.074
5075	Early Lamoille	Farns.	Good	2	13	10	1 2	25	5-14.4	8	- 1.6	8	-14.4	128	1.074
5076	Early Goodrich	Maine	Good	2	18		1 6	30	8- 1.6	19	-12.8	2	1. 1.6	186	1.071
5077	Eight Weeks	"	Good	2	18	30	1 8	26	5- 3.2	8	- 8	4	1- 3.2	128	1.069
5315	Gold Flesh	Ev'tt	Good	2	15		1 10	33	6	19	1- 6.4	6	- 8	147	1.069
5107	Heubner's Badger State	Wis.	Good	2	13	12	1 5	24	5- 1.6	1	- 1.6	9	5- 4.8	195	1.060
5111	Hay's Seedling	Farns.	Good	2	13	10	1 10	65	13-12.8	17	-12.8	16	4- 4.8	351	1.082
5112	Hudson Belle	"	Good	2	15	15	1 5	50	7- 8	16	-12.8	19	4- 8	238	1.080
5114	Houlton Hebron	True	Medium	2	13	11	1 6	41	14- 8	10	- 8	3	-11.2	292	1.074

VARIETIES GROWN ON LIGHT CLAY LOAM.—*Continued.*

Garden No.	NAME.	Seed from.	Condition of seed when planted.	Tubers how cut.	First vegetation.	First blossom.	Av. height of vine	No. merch. tubers.	Weight of same.	No. unmerch. tu'rs	Weight of same.	No. decayed tubers	Weight of same.	Yield per acre.	Specific gravity.
				eyes			ft. in.							bu.	
5117	Hall's Peachblow	Sta	Good	2	June 19	July 17	1 6	28	7-12.8	1	-1 .6			147	1.090
5116	Hampden Beauty	"	Medium	2	13	10	1 2	33	7- 8	11	-8	9	1- 9.6	193	1.092
5119	Improved White Rose	Maine	Good	2	16	17	1 9	44	13- 4.8	13	- 6.4	4	-11.2	268	1.082
5121	Imperial Irish Cup	Putnam	Medium	2	15	15	2	68	10- 8	40	2-11.2	5	- 9.6	256	1.073
5122	Jumbo	Wis.	Good	2	13		1 6	44	12- 1.6	8	- 6.4	2	- 8	242	1.076
5123	Julian	Farns.	Bad	2	13	11	1 7	56	5- 6	15	-6 .4	40	8 -9.6	271	1.082
5124	Jersey Blue	"		2	13		1 6	54	17- 9.6	17	1-	2	-11.2	359	1.069
5126	Joseph Rigault	Vang.	Good	Small whole tubers.	13	10	1 5	22	2- 4.8	34	1- 9.6	6	-11.2	111	1.052
5127	James G. Blaine	N. Y.	Bad	2	14	9	1 4	50	10- 3.2	10	-11.2	13	2-14.4	255	1.082
5128	Cranes June Eating	Mich.	Good	2	13	10	1 3	62	11- 9.6	13	-14.4	13	2-12.8	284	1.078
5130	Jackson White	Maine	Good	2	13	16	2 6	42	18-	6	- 1.6	6	1-11.2	368	1.072
5131	Junkis	Putnam	Good	2	13	29	2 1	71	17 11.2	4	- 1.6	18	6-14.4	459	1.094
5134	Langshan	Md.	Medium	2	13	10	1 5	51	9- 6.4	11	- 9.6	19	6- 8	307	1.079
5135	Lake Erie	Hicks	Good	2	16		1 6	57	12- 9.6	8	- 8	15	4- 1.6	320	1.082
5136	Lombard	Farns.	Ex good	2	17		1 7	31	13- 3.2	7	- 3.2	6	1- 6.4	275	1.069
5137	Late Ohio	Pl't	Good	2	17	18	1 10	31	5-	3	- 1.6	22	8- 8	253	1.060
5138	Lyburui Magnum	Chedel	Ex good	2	17	Aug. 13	2 1	71	13- 3.2	23	1-	1	- 1.6	266	1.075
5139	Lois	Farns.	Good	2	15	July 13	1 6	47	13- 8	12	-11.2	7	2- 8	336	1.085
5140	Lee's Favorite	Sta.	Medium	2	13	10	1 1	40	9- 3.2	10	- 4.8	9	1. 8	201	1.071
5141	Late B. of Hebron	"	Good	2	15	16	1 6	51	16- 8	3	- 1.6	5	1- 1.6	329	1.083
5142	Lady's Finger	"	Medium	Small whole tubers.	13		10	67	6- 1.6	66	2- 4.8	6	- 6.4	163	1.068
5144	Mammoth Prolific	Wis.	Good	2	16		1 4	25	8-12.8	14	- 8	3	1- 1.6	193	1.067
5155	Mrs. Foraker	G. & R.	Medium	2	17		1 6	29	3- 9.6	28	-12.8	19	2- 3.2	133	1.081

VARIETIES GROWN ON LIGHT CLAY LOAM.—*Continued.*

Garden No.	Name.	Seed from.	Condition of seed when planted.	Tubers how cut.	First vegetation.	First blossom.	Average height of vines.	No. merch. tubers.	Weight of same.	No. unmerch. tu'rs	Weight of same.	No. decayed tubers	Weight of same.	Yield per acre.	Specific gravity.
				eyes			ft. in.		lbs. oz.		lbs. oz.		lbs. oz.	bu.	
51-6	Maiden's Blush	Pl't.	Medium	2	June 17		1 5	42	7- 1.6	43	2- 4.8	1	1.6	170	1.081
5148	McNally's Seedling	Bgg.	Medium	2	15	July 11	1 2	17	3- 8	13	9.6	7	1	103	1.149
5149	Minister	Jerr.	Good	2	15	Aug. 1	1 9	17		34	1-14.4				1.036
5150	Monitor	N. Y.	Good	2	16	July 14	1 3	19	2-11.2	9	6.4	10	1-11.2	96	1.066
5153	Mountain White	Farns.	Good	2	16	12	1 1	22	2-11.2	9	3.2	12	1-12.8	87	1.068
5154	Mullally	Sta.	Good	2	13		1 6	24	4-14.4	6	3.2	5	9.6	106	1.052
5155	Mrs. Cleveland	"	Medium	Part whole, Part cut	15	10	1 1	21	2-14.4	15	1	8	1- 1.6	74	1.042
5156	Manhattan	"	Good	2	15		1 5	21	5- 1.6	5	1.6	5	1- 4.8	121	1.060
5157	Modena	Md.	Bad	2	19		1 5	35	4- 8	13	8	14	2- 8	139	1.074
5159	New Wide Awake	Wis.	Good	Whole small tubers.	17	17	1 2	29	5- 3.2	9	8	2	4.8	131	1.070
5161	New Queen	Hicks.	Medium	2	15	13	1 5	35	11- 3.2	1	1.6	3	1- 4.8	234	1.080
5162	Newton Seedling	G. & R.	Good	2	17	Aug. 4	1 6	49	14- 8	5	4.8	1	6.4	282	1.082
5163	Nigger Toe	Farns.	Good	2	16	July 16	2	49	12- 8	6	3.2	1	4.8	242	1.057
5164	Nott's Northern Queen	Nott	Bad	2	15	14	1 4	46	9- 9.6	31	1.12.8	5	6.4	219	1.084
5165	North Pole	Childs	Medium	2	13	14	1 3	50	12- 6.4	14	11.2	1	1.6	245	1.082
5167	New Rose	Allen	Medium	2	12	10	1 3	47	11- 6	4	3.2	2	8	229	1.084
5169	New Zealand	Md.	Good	2	15	16	1 4	34	6- 1.6	6	8	11	2- 8	169	1.081
5172	Orange County White	Maine	Good	2	12	15	1 10	65	22- 4.8	11	4.8	5	2	457	1.077
5173	Old White Carter	Sta.	Good	2	13	10	1 6	35	5- 1.6	29	1- 1.6	21	2-14.4	169	1.103
5174	O. K. Mammoth	"	ExGood	2	12		1 6	54	14-11.2	19	12.8	16	4- 4.8	369	1.075
5180	Pootatuck	Md.	Medium	2	12	11	1 4	36	5- 8	12	6.4	20	4-11.2	197	1.074
5181	Perfection	Farns.	Bad	1	13	10	1 8	44	13- 8	12	9.6	11	4-12.8	381	1.076
5182	Princess	Platt	Bad	2	15	10	1 5	49	5	18	9.6	35	5- 8	223	1.081

VARIETIES GROWN ON LIGHT CLAY LOAM.—*Continued.*

Garden No.	Name.	Seed from.	Condition of seed when planted.	Tubers how cut.	First vegetation.	First blossom.	Average height of vines.	No. merch. tubers.	Weight of same.	No. unmerch. tu'rs	Weight of same.	No. decayed tubers	Weight of same.	Yield per acre.	Specific gravity.
				eyes			ft. in.		lbs. oz.		lbs. oz.		lbs. oz.	bu.	
5185	Parker & Wood's Seedl'g	P. & W.	Good	2	June 16	July 18	1 10	52	15	7	6.4	9	3- 8	351	1.079
5186	Pride of the Market	Till.	Good	2	17		1 4	58	15- 4.8	8	8	3	1- 1.6	314	1.077
5188	Polaris	Allen	Medium	2	13	14	1 3	46	9	7	4.8	21	5- 8	275	1.071
5189	Pride of the Field	Till.	Good	2	15	17	1 10	57	15-12.8	6	8	16	6- 3.2	418	1.069
5190	Pringle's No. 5	Mich.	Good	2	19	20	1 11	43	9-11.2	6	8	6	14.4	206	1.077
5191	" " 1	"	Medium	2	15	22	2 3	68	10-12.8	16	11.2	21	4. 8	297	1.084
5192	" " 2	"	Medium	2	13	22	2 4	64	14- 4.8	13	1- 3.2	2	4.8	294	1.101
5193	" " 3	"	Good	2	15	19	2	50	11- 3-2	24	1-14.4	3	8	253	1.085
5195	Platt's Seedling No. 540	Pl't.	Good	2	17	15	1 7	42	10- 8	5	3.2	11	2- 4.8	242	1.083
5199	Perfect Peachblow	Maine	Good	2	19		1 9	67	15- 1.6	14	1	1	3.2	303	1.081
5200	Pride of Palestine	Sta.	Good	2	13	14	1 7	57	9-12.8	24	1- 9-6	13	1- 8	240	1.082
5201	Purple Blush	"	Bad	2	19		1 5	46	7-11.2	20	1- 1.6	12	1-11.2	195	1.075
5202	Putnam's New Rose	"	Bad	2	15	10	1 1	34	7-12.8	10	8	7	1.14.4	189	1.082
5203	Perfect Gem	"	Good	2	15		1 3	23	7- 1.6	5	1.6	2	6.4	204	1.078
5204	Putnam's Beauty	"	Good	2	15	10	1 5	34	11-11.2	3	3.2	5	1- 8	249	1.074
5205	" Early	"	Medium	2	13	10	11	28	2- 4.8	4	3.2	21	4- 4.8	126	1.077
5206	Pecan	"	Medium	2	13	15	1 2	38	8- 4.8	3	3.2	4	12.8	173	1.088
5207	Quincy	Farns.	Medium	2	13	18	1 10	30	9-14.4	8	8	1	3.2	197	1.075
5210	Queen of the Valley	Sta.	Good	2	15	10	1 4	41	9- 3.2	8	8	12	2- 4.8	223	1.079
5215	Rural N. Y. No. 2	Mich.	Good	2	18	27	1 10	35	14	2	3.2			264	1.074
5219	Red Brooks	Farns.	Good	2	15		1 3	41	11	17	8	7	1-11.2	251	1.064
5220	Rose's Invincible	"	Good	2	15		1 5	32	11-12.8	9	4.8	2	12.8	240	1.062
5253	Thunderbolt	Wis.	Good	2	15	8	1 7	32	10	6	6.4	4	2- 6.4	238	1.098
5254	Tioga	Md.	Good	2	15	19	1 5	35	6- 8	9	4.8	14	2-12.8	179	1.075
5256	Tunxis	"	Medium	2	16	19	1 5	31	9. 1.6	9	4.8	8	1-14.4	209	1.072

VARIETIES GROWN ON LIGHT CLAY LOAM.—*Continued.*

Garden No.	NAME.	Seed from.	Condition of seed when planted.	Tubers how cut.	First vegetation.	First blossom.	Av. height of vine.	No. merch. tubers.	Weight of same.	No. unmerch. tubers.	Weight of same.	No. decayed tubers.	Weight of same.	Yield per acre.	Specific gravity.
				eyes			ft. in.		lb. oz.		lb- oz.		lb. oz.	bu.	
5257	Tonhocks	Hicks	Medium	2	June 13	July 9	1 2	34	6-14.4	6	- 3.2	10	2- 6.4	176	1.086
5262	Thorburn's Late Rose	Maine	Medium	2	15	12	1 6	30	11- 8	3	- 3.2	5	2- 1.6	256	1.165
5263	Tinpe's No. 2	Mich.	Medium	2	17	18	1 3	27	9.12.8	5	- 3.2	1	- 1.6	203	1.076
5267	Vermont Beauty	Farns.	Good	2	18	Aug. 3	1 8	42	11- 4.8	7	- 8	3	1- 1.6	240	1.084
5268	Victory	P. & W.	Medium	2	15	July 11	1 3	28	9- 9.6	14	- 9.6	6	-14.4	206	1.066
5269	Vanguard	Maine	Medium	2	15	10	1 6	34	9-12.8	15	1-	3	-11.2	214	1.083
5270	Vermont Wonder	G. & R.	Bad	2	17		1 2	31	3-14.4	39	2- 4.8	4	- 8	124	1.086
5271	Vermont Champion	Sta.	Medium	2	15	14	1 10	41	14-	12	- 9.6	2	- 8	281	1.076
5323	Victor	Nott	Bad	2	15	11	1 1	36	7-12.8	14	-12.8	5	- 9.6	171	1.082
5275	Well's Puritan	Md.	Medium	2	13	9	1 1	32	7-	26	1-	4	- 6.4	156	1.080
5276	Woodbury's White Sport	G. & R.	Medium	2	13	10	1 2	33	11-14.4	6	- 3.2	2	- 4.8	230	1.088
5277	White Lily	"	Medium	2	13		1 6	34	9-14.4	2	- 1.6	1	- 4.8	191	1.094
5278	Webb's Early	Farns.	Medium	2	13	10	1 3	34	8-14.4	15	1- 1.6	1	- 1.6	188	1.078
5280	White Flower	Pl't.	Good	2	15		1 6	42	12-14.4	5	- 1.6			242	1.084
5281	White Beauty	N. Y.	Good	2	15		1 3	42	9-11.2	13	- 6.4	4	-11.2	201	1.067
5282	White Bermuda	"	Good	2	13		1 4	35	11-14.4	10	- 6.4			228	1.064
5283	White Prize	Mle	Good	2	13	9	1 3	35	7- 4.8	13	-14.4	11	2- 4.8	195	1.077
5284	Waugh's Seedling, No. 41	N. Y.	Good	2	15		1 3	29	5- 8	14	-11.2	4	-11.2	128	1.094
5286	" " 45	"	Good	2	16		1 4	10	1- 4.8	14	- 9.6	4	- 9.6	100	1.067
5287	" " 49	"	Good	2	17		1 2	39	7- 6.4	38	2- 1.6	3	- 3.2	180	1.064
5288	" " 37	"	Good	2	15		1 2	36	7- 6.4	18	1- 6.4	6	1- 1.6	184	1.075
5299	" " 39	"	Good	2	17		1	17	1-14.4	20	. 9.6	14	1- 1.6	67	1.063
5290	Wild Mexican	Mich.	Good	2	15	31	1 3	3	- 6.4	132	4- 8	3	- 1.6	86	1.067

VARIETIES GROWN ON LIGHT CLAY LOAM.—*Continued.*

Garden No.	NAME.	Seed from.	Condition of seed when planted.	Tubers cut.	First vegetation.	First blossom.	Av. height of vines.	No. merch tubers.	Weight of same.	No. unmerch. tubers.	Weight of same.	No. decayed tubers.	Weight of same.	Yield per acre.	Specific gravity.
				eyes			ft. in.		lb. oz.		lb. oz.		lb. oz.	bu.	
5291	West's No. 1	Mich.	Good	2	June 15		1 1	35	6- 4.8	14	-14.4	7	1- 1.6	154	1.077
5293	Windsor No. 1	Minn.	Bad	2	15	July 18	10	9	1- 3.2	29	-12.8	6	- 3.2	44	1.069
5295	White Champion	Farns.	Ex.good	2	17	18	1 4	41	10-14.4	4	- 4.8	3	1-	227	1.086
5296	White Elephant	Maine	Good	2	13	17	1 7	46	12- 3.2	19	-12.8	6	1-11.2	273	1.077
5297	Watson's Seedling	"	Good	2	15	13	1 10	36	11- 6.4	14	- 9.6	2	- 1.6	225	1.085
5298	White Seedling	"	Good	2	15	20	1	26	7- 1.6	9	- 6.4	5	1- 8	167	1.045
5300	White Star	Sta.	Good	2	15	20	1 3	35	13-	9	- 8	1	- 6.4	258	1.058
5301	Wood Ants	"	Medium	2	13		1 1	27	3-14.4	11	-11.2	7	1- 6.4	111	1.069
5302	Wall's Orange	"	Good	2	15		1 7	42	9- 8	13	1- 1.6	5	-14.4	214	1.083
5322	White B. of Hebron		Good	2	15	16	1 5	43	9- 6.4	14	- 8	7	1- 1.6	204	1.079
5305	Yosemite	Farns.	Good	2	13	19	1 7	33	6- 2	13	-12.8	3	- 6.4	134	1.080

POTATOES ON CLAY SECTION.

Garden No.	NAME.	Seed from.	Condition of seed when planted.	Tubers—how cut.	First vegetation.	First blossom.	Av. height of vine.	No. merch. tubers.	Weight of same.	No. unmerch. tubers.	Weight of same.	No. decayed tubers.	Weight of same.	Yield per acre.	Specific gravity.
				eyes.	June	July	ft. in.		lbs. oz.		lbs. oz.		lbs. oz.	bu.	
2978	Barrow's Perfection	Minn.	good	part whole	15	......	10	19	3- 1.6	3	3.2	2	4.8	67	1.076
2979	Boley's Northern Spy....	Wilson	"	part cut 2	18	16	1- 6	24	5	1	1.6	11	4- 6.4	176	1.075
2980	Bliss' Alpha............	Rawson	"	sma'l whole tubers	15	18	-10	2	6.4	24	1- 6.4	..	....	33	1.066
2981	Baraboo White..........	N. Y.	"	2	17	......	1- 5	32	5-12.8	11	4.8	15	3- 9.6	180	1.071
2982	Brown Beauty...........	"	"	2	17	......	1	19	1- 9.6	10	8	12	1-11.2	70	1.078
2983	Buffalo Bill	"	med.	2	17	19	11	11	2- 3.2	8	9.6	3	9.6	63	1.065
2984	Beal's Wild..............	"	good	whole small tubers	15	21	1- 2	1	3.2	163	5- 1.6	34	1- 3.2	121	1.062
2985	Bliss' Rough Diamond...	Hal.	bad	part whole	13	......	1- 1	25	3- 3.2	45	1-12.8	15	1- 3.2	115	1.086
2986	Belle..................	Minn.	med.	part cut 2	18	16	11	11	2- 4.8	4	3.2	2	6.4	53	1.064
2987	Bucyrus	"	good	2	18	......	6	11	8	6	9.6	10	1- 6.4	46	1.076
2988	Blacks Chinango....	Farns.	med.	2	17	25	1- 5	21	2- 4.8	22	1- 1.6	7	1	88	1.071
2990	Burbank's Sport.........	Maine	ex. good	2	17	......	1- 5	45	10-12.8	6	12.8	5	1- 6.4	242	1.073
2991	Bonanza	Wis.	good	2	15	29	1- 6	37	8- 8	15	14.4	8	2-12.8	227	1.094
2992	Badger Queen...........	Vaughn.	ex. good	2	15	15	1- 3	35	9- 8	...	....	10	3-14.4	247	1.147
2993	Bliss' Triumph	Sta.	"	2	17	......	1	33	7- 4.8	19	1- 3.2	..	....	158	1.067
2994	Brownell's Best.........	"	good	2	17	16	1- 6	49	14.8	14	14.4	1	3.2	290	1.076
2995	Burbank's Seedling......	"	"	2	17	......	1- 5	51	13- 6.4	3	3.2	..	....	253	1.092

POTATOES ON CLAY SECTION.—*Continued.*

Garden No.	NAME.	Seed from.	Condition of seed when planted.	Tubers—how cut.	First vegetation.	First blossom.	Av. height of vine.	No. merch. tubers.	Weight of same.	No. unmerch. tubers.	Weight of same.	No. decayed tubers.	Weight of same.	Yield per acre.	Specific gravity.
				eyes.	June	July	ft. in.		lbs. oz.		lbs. oz.		lbs. oz.	bu.	
2996	Brownell's Winner	Brownell	good	2	15	18	1- 4	35	9-11.2	7	8	1	8	199	1.079
2996 A	Beauty of Hebron	....	bad	2	15	12	1	33	8- 9.6	10	12.8	3	12.8	189	1.080
2999	Crown Jewel	Md.	"	2	15	15	1- 2	35	7- 3.2	17	1	7	1- 8	180	1.166
3000	Champion of America	"	good	2	17	13	1- 5	24	4-12.8	8	4.8	10	4- 4.8	174	1.070
5078	Early King	Sta.	ex. good	2	15	......	1- 6	20	5- 9.6	6	4.8	4	9.6	131	1.063
5079	" Washington	"	good	2	19	Aug. 1	1- 6	19	2- 9.6	25	4.8	18	14.4	76	1.076
5081	" Essex	"	"	2	17	J'ly 18	1- 5	19	5	21	12.8	7	1- 1.6	128	1.073
5082	" Electric	"	"	2	19	......	1	13	1- 4.8	9	3.2	13	1- 3.2	50	1.064
5083	" Oxford	Greg.	med.	2	15	12	1- 1	31	6-14.4	18	12.8	13	1-11.2	167	1.075
5084	" Standard	Sta.	bad	2	18	16	1	24	3	18	9.6	17	2- 8	113	1.083
5085	" Rose	"	good	2	17	15	1- 6	28	9	16	14.4	10	2- 4.8	227	1.080
5086	" Sunrise	"	"	2	15	16	1- 3	28	6- 4.8	17	8	16	2- 4.8	169	1.091
5087	Excelsior	"	bad	2	19	......	1- 1	17	3- 4.8	30	1- 6.4	4	6.4	94	1.079
5310	Early Mayflower	....	ex. good	2	21	......	1	10	1- 4.8	20	9.6	13	11.2	48	1.073
5311	Ex. Early Vermont	....	bad	2	21	......	1- 3	24	5-12.8	15	8	5	6.4	124	1.077
5312	Everitt	Ev'tt.	good	2	20	20	1- 2	26	4- 8	24	1- 4.8	9	1- 1.6	128	1.067
5089	Flint's Seedling	....	bad	2	18	18	1	16	2- 6.4	18	14.4	5	14.4	78	1.082
5093	Gen. McLellan	Wis.	good	small whole tubers	20	......	1- 5	10	1- 9.6	3	1.6	5	1- 1.6	52	1.072
5097	Grange	Md.	"	2	17	31	1- 5	29	4- 4.8	20	12.8	19	3- 8	160	1.076
5098	Gov. Foraker	G. & R.	"	2	19	17	1- 3	24	5-14.4	15	9.6	7	1- 1.6	141	1.065

POTATOES ON CLAY SECTION.—*Continued.*

Garden No.	NAME.	Seed from.	Condition of seed when planted.	Tubers—how cut.	First vegetation.	First blossom.	Av. height vine.	No. merch. tubers.	Weight of same.	No. unmerch. tubers.	Weight of same.	No. decayed tubers.	Weight of same.	Yield per acre.	Specific gravity.
				eyes.	June	July	ft. in.		lbs. oz.		lbs. oz.		lbs. oz.	bu.	
5099	Goucher	Farns.	med.	2	19	......	1- 3	48	8-11.2	19	1-	11	1- 9.6	210	1.059
5100	Golden Ball	Childs	good	2	19	......	2	27	5	43	1- 6.4	16	14.4	135	1.072
5102	Green Mountain	Alex.	"	2	17	13	1- 6	39	9-14.4	8	4.8	11	2-14.4	243	1.079
5103	Garrison's No. 8	Md.	"	2	18	22	1- 8	47	11-8	23	1- 8	3	12.8	256	1.077
5104	Garfield	Maine	"	2	15	12	1- 9	37	12-14.4	6	3.2	5	1- 8	271	1.075
5106	Gregory's No. 1	Sta.	med.	part whole part cut	14	6	1- 3	33	6-14.4	26	1- 9.6	15	2- 1.6	233	1.079
5221	Rose's Wild	Farns.	good	2	19	23	1- 3	18	5- 3.2	2	1.6	..	......	106	1.082
5223	Rosy Morn	Plt.	med.	2	16	12	1- 2	32	6-12.8	17	4.8	18	2- 9.6	180	1.077
5225	Rose's New Giant	Maine	good	2	18	27	1- 4	21	9- 3.2	6	1.6	8	2- 4.8	215	1.045
5226	Rose's Magnum Bonum	"	med.	2	18	17	1- 2	20	5-14.4	16	14.4	10	2- 4.8	169	1.075
5227	" Beauty of Beauties	"	good	2	17	......	1- 1	21	6- 8	17	6.4	3	14.4	145	1.067
5228	Red Elephant	"	med.	2	17	13	1- 2	23	8	6	3.2	4	12.8	167	1.075
5230	Randall's Beauty	Sta.	good	2	15	19	11	22	4-11.2	11	6.4	..	......	94	1.056
5231	Rochester Favorite	"	med.	2	17	15	1- 2	23	8- 4.8	9	3.2	4	12.8	173	1.050
5232	Red Giant	G. & R.	"	2	17	28	1- 2	27	2- 1.6	16	6.4	28	3- 8	111	1.039
5237	Sunlit Star	Hicks	"	2	16	16	1-	24	3	2	0.5	13	2.4	98	1.077
5238	Summit	"	"	2	17	11	1- 8	34	8- 4.8	14	4.8	14	2- 9.6	202	1.083
5241	Seneca Beauty	Liv.	good	2	18	27	1- 4	31	6-11.2	6	3.2	7	1- 8	156	1.081
5242	Seedling No. 37	Bpee.	med.	2	18	13	1	28	5- 3.2	8	8	4	8	124	1.076
5243	Stratagem	Alex.	good	2	19	19	1- 3	26	7- 1.6	5	3.2	3	1	154	1.076

POTATOES ON CLAY SECTION.—*Continued.*

Garden No.	NAME.	Seed from.	Condition of seed when planted.	Tubers—how cut.	First vegetation.	First blossom.	Av. height of vine.	No. merch. tubers.	Weight of same.	No. unmerch. tubers.	Weight of same.	No. decayed tubers.	Weight of same.	Yield per acre.	Specific gravity.
				eyes.	June	July	ft. in.		lbs. oz.		lbs. oz.		lbs. oz.	bu.	
5244	Sylvan	N. Y.	good	2	23	......	1-	11	1- 3.2	30	1-	14	1-	58	1.074
5245	Snowflake	Md.	"	2	19	23	1- 4	25	5-14.4	9	8	1	1.6	121	1.078
5249	Stranger	Farns.	"	2	15	29	1- 3	47	6-14.4	16	9.6	6	1- 1.6	160	1.065
5250	St. Patrick	Maine	"	2	18	......	1- 6	34	6- 6.4	12	4.8	6	3.2	128	1.127
5251	Snow Queen	Sta.	med.	2	19	......	1- 1	13	1-12.8	20	1- 1.6	5	12.8	74	1.074
5252	Seneca Red Jacket	"	good	2	18	Aug. 3	1- 4	27	7- 6.4	4	3.2	3	11.2	167	1.076
5252 A	Superior	Mich.	med.	2	19	......	1- 4	37	6-12.8	11	9.6	7	1- 4.8	161	1.071

NEW VARIETIES OF POTATOES.

Below is given a list of potatoes grown at the Station for the first time. The seed tubers were collected from different sources, and had probably been kept under as many different conditions. They received the same treatment as the other varieties, being planted in the same field.

The data collected during the season are given below:

Garden No.	Name.	Seed from.	Condition of seed when planted.	Tubers how cut	First vegetation.	First blossom.	Average height of vine.	No. merch tubers.	Wt. of same.	No. umerch tubers.	Wt. of same.	No. decayed.	Wt. of same.	Yield per acre.	Spec. gravity.
				2 eyes	June.	July.	ft in		lbs. oz.		lbs.oz		lbs.oz	Bu.	
2954	Arizona	Vaughn	Good	" "	13	12	2	60	12- 8.	25	1- 6.4	20	4- 6.4	340	
5091	Badger State	Hicks	Med.	" "	15	18	-10	23	3- 3.2	6	- 4.8	4	1- 1.6	85	1.068
5092	Bill Nye	Hen.	Bad	" "	17		1- 4	42	8- 9.6	16	-12.8	8	1- 8	202	1.071
5094	Bouk's Prize Taker	Bouk.	Med.	" "	16		- 8	12	2- 1.6	19	-12.8	4	- 3.2	85	1.076
5105	Cambridge Prolific	Gid.	"	" "	13	12	-11	36	9- 6.4	11	- 6.4	1	- 1.6	184	1.083
5113	Chessman's Seedling	R. I.	Good	" "	18	27	1- 3	39	10- 8.	4	- 3.2			199	1.062
5132	Churchill's "	" "	"	" "	13		1- 4	23	9-12.8	10	- 1.6			184	1.066
5147	Dreer's Standard	Dreer	Med.	" "	13	14	1- 3	32	10- 1.6	6	- 6.4	3	1- 3.2	217	1.070
5336	Enos' Seedling	R. I.	Good	" "	17		1- 5	19	3- 3.2	32	1- 6.4	4	- 8.	94	1.068
5029	Early Allino	Wis.	Med.	" "	13	10	1	37	5-12.8	11	- 9.6	9	1- 6.4	145	1.074
5196	Fillbasket	Howe	Good	" "	19	22	1- 2	31	6- 3.2	29	- 6.4	8	1- 6.4	167	1.070
5197	Family Pride	Nel.	Med.	" "	19	16	1	18	2- 8.	20	-11.2	12	2- 3.2	100	1.075
5337	Gidding's Early	Gid.	Good	" "	15	14	1- 3	52	10-11.2	17	-11.2	14	2-11.2	262	1.072
5216	Gov. Rusk	Salz.	"	" "	13		-11	34	3-14.4	12	1- 1.6	20	4-12.8	187	1.077
5294	Golden Beauty	Howe	"	" "	13	10	-11	31	3- 1.6	25	-11.2	26	2- 1.6	109	1.065
5109	Halo of Dakota	Hicks	Med.	" "	13	11	1- 6	53	13-11.2	13	-12.8			269	1.089
5110	Hotel Favorite	"	Good	" "	16		1- 6	40	13- 1.6	5	- 1.6	2	- 3.2	249	1.084
5013	Howe's Premium	Howe	Ex "	" "	13	12	1	28	8- 8.	13	-14.4	2	- 8.	184	1.075
5125	Harlinger	Jerrard	Ex "	" "	13	15	1- 8	80	11- 6.4	40	2- 1.6	17	2- 6.4	295	1.080
5108	Hen. Early Puritan	Hen.	Med.	" "	15	14	1-	44	6-14.4	28	1- 8	7	-14.4	173	1.078

NEW VARIETIES OF POTATOES.—*Continued.*

Garden No.	Name.	Seed from.	Condition of seed when planted.	Tubers how cut	First vegetation.	First blossom.	Average height of vine.	No. merch tubers.	Wt. of same	No. umerch tubers.	Wt. of same.	No. decayed.	Wt. of same.	Yield per acre.	Spec. gravity.
				2 eyes	June.	July.	ft.		lbs. oz.		lbs. oz		lbs. oz	Bu.	
5235	Iron-clad	Salz.	Good	" "	13		-10	35	6- 1.6	30	1- 9.6	7	1- 1.6	193	1.071
5133	Lake Michigan	Wis.	"	" "	15		1- 7	59	19	6	- 9.6	4	- 12.8	379	1.093
5168	Lake George	Hicks	"	" "	13		1	34	3- 11.2	11	- 8	8	1	96	1.072
5152	Manitoba	Nott	"	" "	17		.12	17	4- 12.8	6	- 6.4			104	1.064
5025	Marble City	Hicks	"	" "	15		1- 4	22	4- 1.6	22	- 11.2	14	2- 3.2	111	1.067
5184	Mam'th White Chief	Bouk.	Med.	" "	16		- 9								1.059
5158	Mitchell's Seedling	R. I.	Good	" "	15		1- 2	24	5- 9.6	11	- 8	1	4.8	119	1.079
5248	Moore's Seedling	R. I.	"	" "	15	15	1- 5	48	9- 9.6	2	- 1.6	11	3- 4.8	242	1.078
5292	Nathan's Rose	Perry	Med.	" "	12	12	1- 5	52	14- 11.2	7	- 6.4	6	2	318	1.086
2325	Niagara	Hicks	Good	" "	12	11	1- 6	57	11- 8	24	1	17	2- 1.6	271	1.070
5171	Ohio Junior	Vick	Med.	" "	17	16	1- 4	34	3- 6.4	7	- 6.4	18	5- 3.2	167	1.072
5326	Peachblow (Orig.)	Wheeler	Good	" "	15	13	1-10	40	7- 1.6	18	1- 4.8	3	- 9.6	167	1.092
5328	Pride of the West	Hen.	Bad	" "	20	30	1- 4	27	9- 1.6	12	- 8	1	- 4.8	199	1.065
5327	People's Potato	Maule	Med.	" "	16		1- 2	30	5- 9.6	13	- 6.4	4	- 8	130	1.045
5329	Rising Sun	Gid.	"	" "	18	15	1- 1	28	5- 9.6	3	- 1.6	10	2- 8	152	1.083
5330	Silver Chili	R. I.	"	" "	17	18	1- 4	29	5- 14.4	20	1- 6.4	4	- 14.4	152	1.072
5331	Six Weeks Market		"	" "	14		-10	15	1- 14.4	8	- 8	5	- 11.2	58	1.072
5332	Stanton Seedling	R. I.	Good	" "	15	14	1- 3	32	8- 1.6	13	- 9.6	6	- 14.4	178	1.083
5333	Storrs' Seedling	" "	"	" "	17	30	1- 4	33	10- 8	22	1- 9.6	2	- 8	234	1.080
5266	Vicks' Early	Wis.	Med.	small whole tubers	17		1- 1	21	3- 4.8	12	- 9.6	9	1- 6.4	106	1.072
5334	" Perfection	Vick	"	2 eyes	13	11	1- 3	41	9- 1.6	14	- 14.4	2	- 8	195	1.084
5335	Winslow's Seedling	R. I.	"	" "	15	14	1- 2	32	8- 3.2	4	- 3.2			156	1.077

TOMATOES.

Thirty varieties of Tomatoes, five plants of each, were set in the field June 18, in rows six feet apart and five feet in the row.

Green Mountain gave the first 10 ripe fruit. Although early it is not a profitable variety to grow, being wrinkled and irregular in form.

Fulton Market may be included in the same class, although not quite so wrinkled.

The tests this season bear out the conclusions of last season's tests, viz; that in the varieties of recent introduction we have nothing that is better than Livingston's Paragon, Perfection, etc.

The Ignotum is the only exception, it certainly equals the above, and further tests may prove that it excels them.

The data collected during the season are given in the following table :

Garden No.	NAME.	Seed from	When sown.	When planted in field.	First blossom.	First ripe fruit.	Days from planting.	First 10 ripe fruit.	Days from planting.
			May	June	June	Aug.			
2873	Acme	Liv.	2	18	24	9	99	Aug. 29	119
2863	Advance	Mle.	2	18	29	20	110	Sep. 7	128
2866	Atlantic Prize	J. & S.	2	18	24	9	99	Aug. 21	111
2888	Beauty	Liv.	2	18	25	9	99	Sep. 2	123
2868	Buist's Beauty	Buist	2	18	24	25	115	12	133
5351	Canada Victor	Hen.	2	18	25	9	99	Aug. 18	108
5350	Chemin	Bpee.	2	18	30	25	115	Sep. 7	128
5353	Early Ruby	....	2	18	24	8	98	Aug. 14	104
2871	Essex Hybrid	Low	2	18	25	11	101	29	119
2874	Ex Early or Cluster	Mich.	2	18	24	7	97	30	120
2887	Favorite	Liv.	2	18	26	12	102		
2875	Fulton Market	Greg.	2	18	24	6	96	12	102
5354	Glen Cove	Bpee.	2	18	25	29	119	Sep. 10	131
2877	Golden Queen	Liv.	2	18	25	10	100	7	128
5385	Green Mountain	Gidd.	2	18	24	7	97	Aug. 9	99
2880	Haine's No. 64	N.B & G	2	18	25	3	93	16	106
2881	Ignotum	Mich.	2	18	25	11	101	Sep. 2	123
2890	Matchless	Bpee.	2	18	25	10	100	14	135
2895	New D'f Champion	Liv.	2	18	25	11	101	7	128
2897	New Peach	"	2	18	30	20	110		
2898	New Zealand Fig	"	2	18	23	9	99	Aug. 12	102
2899	Optimus	Ferry	2	18	25	10	100	Sep. 7	128
2904	Paragon	Liv.	2	18	25	10	100	Aug. 29	119
5355	Perfection	"	2	18	25	7	97	Sep. 2	123
2905	Prelude	Hors.	2	18	25	9	99	Aug. 12	102
2906	Puritan	Raw.	2	18	25	29	119		
2913	Shah	Hen.	2	18	24	11	101	24	114
5357	Table Queen	"	2	18	25	20	110	Sep. 14	135
5356	Trophy	"	2	18	25	12	102	7	128
5358	Yellow Cherry	Hal.	2	18	20	1	91	Aug. 5	95

TURNIPS.

Seed of the following varieties of turnips were sown on June 17, in drills 16 inches apart, 25 feet in length. Afterwards thinned to about six inches in the row.

The tabulation following gives the data collected during the season:

Garden No.	NAME.	Seed from	When sown.	First vegetation.	Length of row.	Total No. roots.	No. marketable.	Weight of same.	No. unmarketable.	Weight of same.
			J'ly	J'ly	ft.			lbs. oz.		lbs. oz.
2935	Aberdeen (or Scotch Yellow)	Land.	17	23	25	19	14	6- 1.3	5	0- 3
2920	Earliest Bloomsdale Red Top	"	17	21	25	45	20	8- 7.2	25	3- 3.2
2921	Early Snowball	"	17	22	25	42	31	25-15.1	11	2-10.2
2922	" Lacrosse	Salz.	17	22	22	35	25	20- 4	10	1-13.2
2923	" White, 6 weeks	Mle.	17	23	22	27	11	4-15	16	2- 7
2924	" Milan	Low	17	23	11	34	25	17-11.3	9	1- 4.3
5565	Golden Ball (or Orange Jelly	Bgg.	17	21	22	22	11	4-14.2	11	1-15.2
2925	Milk	Salz.	17	21	22	44	18	10-13	26	5-11.3
2944	Montmagny	Sib.	17	23	25	28	14	7- 5.1	14	2- 3
2927	New Red Top Olive	Land.	17	22	22	33	22	13-15.1	11	1-11
2930	" " Strap Leaf	Mle.	17	24	22	31	15	9- 1.5	16	3- 0
2929	Red Top White Globe	"	17	22	25	32	22	15- 2.3	10	2- 0.2
2931	White Egg	Greg.	17	22	22	35	15	6-14.1	20	3-12.1
2932	White Lily	Salz.	17	21	22	43	29	16- 5	14	3-14.2

SWEDISH TURNIPS.

Seeds of the following varieties of Swedes were sown on June 17 in drills 16 inches apart, 25 feet in length; afterwards thinned to about 10 inches in the row.

Garden No.	NAME.	Seed from.	When sown.	First vegetation.	Length of row.	Total No. roots.	No. marketable.	Weight of same.	No. unmarketable.	Weight of same.
			J'ly	J'ly	ft.			lbs. oz.		lbs. oz.
2934	Am. Ruta Baga	Moore	17	22	25	25	20	15- 1.1	5	1- 4
2934 A	" " "	Greg.	17	22	25	23	14	5- 4.3	9	1-12.2
2934 B	" " "	Moore	17	22	25	26	15	7- 9	11	2-10.3
2936	Bloomsdale Swede	Land.	17	22	25	33	20	10- 5.2	13	3- 8.3
2919	Bread-Stone	Bpee.	17	22	25	27	16	6-13.1	11	2-13
2937	Budlong's White	Greg.	17	22	25	32	15	7- 2.2	17	4-10.2
2938	Golden Swede	"	17	23	25	28	10	5-15	18	4- 3
2938 A	Golden Crown	Moore	17	21	25	32	18	12-11.1	14	4- 3.3
2939	Heavy Cropper	Mle.	17	25	25	21	5	2- 2.3	16	2- 8.3
2940	Imp. Purple Top	Bpee.	17	23	25	28	13	5- 1.2	15	3- 5.2
2941	L. I. Imp. " "	Hen.	17	21	25	29	16	8- 8.2	13	3- 3.2
2943	Mammoth Russian	....	17	24	25	17	7	4- 6	10	2- 6.3
2942	Melting Swede	Simmers	17	22	25	30	16	7- 1.2	14	3- 1.2
5564	Monarch	Moore	17	22	25	24	11	5- 0	13	3- 4
2945	Westbury Swede	Low	17	23	25	24	8	3-15	16	3- 4.2
2946	White Swede (or Russian)	Sib.	17	23	25	19	3	1-11.2	16	4- 8.2

VERMONT AND MARYLAND POTATO TEST.

LATITUDE, ITS EFFECT UPON THE PRODUCTIVENESS OF POTATO TUBERS.

An experiment was commenced in the spring of '88, in connection with the Maryland Experiment Station, to test the relative value of Northern and Southern potato tubers.

Seed tubers were exchanged in each case that had been grown the year previous at the home station, but which had been obtained at the first from different sources.

The test was continued the past season, and to eliminate the error of seed tubers from different sources, the tubers exchanged were selected from both Vermont and Maryland tubers grown in '88 at the home Station.

At the Vermont Station the land was ploughed, harrowed over, then a complete fertilizer was applied broadcast at the rate of 800 lbs. per acre, and harrowed in ; rows were furrowed out three feet apart, tubers were cut to two eyes and the duplicate of each variety made to weigh the same; planted May 30th, eighteen inches apart in the row and covered about four inches deep.

The season was quite favorable for the growth of the potato on this variety of soil, viz.: light clayey loam. On heavier soils blight and the subsequent decay of the tuber prevailed to a considerable extent.

This special plat received the same treatment as the large field containing the variety tests, viz.: the application of the Bordeux mixture with Paris green, and fortunately the vines suffered but very little, if any, from the blight.

The potatoes were all dug on October 3rd, each variety placed in a box by itself, and removed to the root cellar when thoroughly dry.

At the Maryland Station, a fertilizer composed of dried fish and muriate of potash was applied to the plat, at the rate of 850 lbs. of fish and 300 lbs. of potash per acre ; this was applied broadcast and harrowed in. The rows were three feet six inches apart and the pieces of seed tubers dropped once in eighteen inches. These were planted on the 12th of April two eye pieces being used and duplicates made to weigh alike.

In a few cases, the Maryland tubers being small, a whole tuber was used after cutting out all eyes but two, and they were covered about four inches deep.

No date was given of the time of digging the Maryland seed.

In comparing the results it will be seen that Northern grown seed still holds the position taken last season. It is proposed to continue the tests another season under like conditions. Following is the result of the test in tabular form :—

COMPARISON OF POTATOES FROM NORTHERN AND SOUTHERN SEED.

No.	TWELVE HILLS.	Yield from Verm'nt seed at Vermont Exp. Station.						Yield from Maryl'd seed at Vermont Exp. Station.						Yield from Verm'nt seed at Maryland Exp. Station.						Yield from Maryl'd seed at Maryland Exp. Station.					
	NAME.	Merch.		Unmerch.		Total.		Merch.		Unmerch.		Total.		Merch.		Unmerch.		Total.		Merch.		Unmerch.		Total.	
		lbs.	oz	lbs.	oz	lbs.	oz	lbs.	oz	lbs.	oz	lbs.	oz	lbs.	oz	lbs.	oz	lbs.	oz	lbs.	oz	lbs.	oz	lbs.	oz
5308	Dakota Red	12	15		2	13	1	5	9		10	6	3	8	1	1	2	9	3	2	15	2	4	5	3
5307	Delaware	11	7		3	11	10	7	8		11	8	3	2	10	2	14	5	8	1	12	2	7	4	3
5314	Farina	11	2	1	1	12	3	4	3		10	4	13	1	7	1	7	2	14		11	1	12	2	7
5316	Home Comfort	12	8		5	12	13	7	2	1	1	8	3	2	13	1	7	4	4		15	1	4	2	3
5317	Morning Star	12	3		1	12	4	5	9	1	5	6	14	4	8	1	15	6	7		3	2	2	2	5
5318	Munroe Co. Prize	13	6		2	13	8	5	4	1	5	6	9	3	4	2	4	5	8	2	6	3	2	5	8
5319	Rural Blush	18	9		7	19		12	12		9	13	5	6		3	3	9	3	4		2	8	6	8
5320	Stray Beauty	11			3	11	3	6	3	1	3	7	6	3	10	2	6	6			13	2	6	3	3
5321	Thornburn	21	3	1	2	22	5	10	3	1	8	11	11	8	3	4	10	12	13		14	3	5	4	3
5322	White B. of Hebron	21	5	......		21	5	12	5	1	3	13	8	6	5	3	8	9	13	5	14	5	4	11	2

BORDEAUX MIXTURE WITH PARIS GREEN.

The results last season were so favorable from the use of the Bordeaux mixture in preventing or rather checking the action of the potato blight (*Phytophthora infestans*), that it was decided to commence operations the present season *before* the blight showed itself.

On July 8 the potato bug (*Doryphora decemlineata*), had become quite numerous, and it was decided to give the first application.

The mixture was made up after the following formula :

Copper sulphate (blue vitriol or blue stone)	6 pounds.
Lime	4 "
Water	22 gallons.

Careful directions for mixing and applying are given in the Botanist's report, so we will not give them here.

To 3 gallons of this mixture ½ oz. of Paris green was added, kept constantly stirred and applied to the vines with a common watering pot; ¼ oz. was used at first, but did not seem of sufficient strength to kill the larvæ.

Using ½ oz. of Paris green to 3 gallons of the mixture made a solution of 1 to 96, which is twice as strong as is recommended when Paris green is used alone.

Care should be taken in using a solution stronger than 1-200, unless one is well satisfied that a stronger solution will not injure the vines, and that it is necessary to kill the larvæ.

Three more applications were made during the season on the following dates: July 18th, August 1st and August 18th.

The results were very satisfactory. Black spots on the leaves from the first of August showed that the blight fungus was present in all parts of the field, ready to spread as soon as the weather was favorable

On an adjoining plot which was not sprayed it did spread in the latter part of August, killing all the vines within a week, but it did not spread on the treated field, and these vines remained green, excepting the scattered black spots on the leaves until killed by frost. In the tabulations given on potatoes, is combined the results of this test; the number and weight of decayed tubers is given for each variety.

Combined in the Botanist's report is the results obtained from the above mentioned plat adjoining the large field treated; this brings out more fully the effect of the mixture, and is well worth the careful study of every potato grower.

THE FRUIT DEPARTMENT.

The winter of 1889-90 was not favorable for small fruits, especially in the situation occupied by them at this Station. The field being situated on the crest of a hill, has the full sweep of the wind for many miles. While we had but little snow in any place during the winter none stayed on this field over ten hours. Consequently very little protection was afforded the roots of plants, and a good test was given the varieties.

All the apples, pears, plums, cherries, currants and gooseberries were uninjured. Arch Duke, Early Richmond and Montmorency of the cherries gave the first fruit.

The following list of grapes produced from one to three clusters:

Agawam,	Cottage,	Early Victor,	Moore's Diamond,
Amber Queen,	Concord,	Hartford,	Othello,
Black Eagle,	Delaware,	Ives,	Wyoming Red.
Barry,	Eaton,	Lady,	
Clinton,	Elvira,	Moore's Early.	

BLACKBERRIES.

Of the list of blackberries given in our report for 1889, Snyder, Stone's Hardy and Taylor's Prolific, withstood the winter almost perfectly; all of the other varieties were so injured that we cannot recommend them unless protection can be given.

DEWBERRIES.

Both varieties of dewberries, Mammoth and Lucretia, were killed to the ground.

CURRANTS.

All currants withstood the winter without injury. Fay's Prolific and Cherry are the most desirable red varieties; White Grape the best white variety, and Black English a good black variety.

GOOSEBERRIES.

The varieties withstood the winter well, but have made a slow growth and require further test.

RASPBERRIES.

All raspberries were more or less winter killed, Turner and Cuthbert giving the best results, also the largest returns in fruit, and in our tests so far prove the most desirable varieties to grow for the home garden, Turner being too soft to ship any distance. Caroline proves the best yellow variety.

The blackcap have proved a failure in their present situation and will require further trial.

STRAWBERRIES.

Of the forty-four varieties of strawberries grown Bubach and Haverland have given the best satisfaction and are worthy of further trial.

ACKNOWLEDGMENTS.

We wish to express our thanks to the following list of firms who have filled our orders the past season free of charge :

O. H. Alexander, Charlotte, Vt.

Joseph Harris Seed Co., Rochester, N. Y.

Idaho Pear Co., Lewiston, Idaho.

C. E. Allen, Brattleboro, Vt.

Seeds or plants have been sent by the firms mentioned below either on their own responsibility or with orders.

W. Atlee, Burpee & Co., Philadelphia, Pa.

H. A. March, Fidalgo, Washington.

Northrup, Braslan & Goodwin Co., Minneapolis, Minn.

R. & J. Farquhar, Boston, Mass.

Peter Henderson & Co., New York, N. Y.

Wm. H. Maule, Philadelphia, Pa.

John Lewis Childs, Floral Park, N. Y.

Johnson & Stokes, Philadelphia, Pa.

Jacob C. Bauer, Judsonia, Ark., 12 plants Van Deiman Strawberry.

J. C. Lovett Co., Little Silver, N. J., 12 plants Shuster's Gem Strawberry, 12 plants Lovett's Early, 6 plants Lovett's Black Cap Raspberry, 3 plants Jewett's Blackberry.

Stephen Hoyt's Sons, New Canaan, Conn., 2 Green Mountain Grapes.

Norman Stuart, St. Remi, Que., cions of Seedling Apple.

Hatch Experiment Station, Amherst, Mass., 3 varieties of Strawberries.

Department of Agriculture, Washington, D. C., Division of Pomology, Seeds of *Prunus sub-cordata.*

Department of Agriculture, Washington, D. C., various packets of seeds, varieties of Willow cuttings.

INDEX.